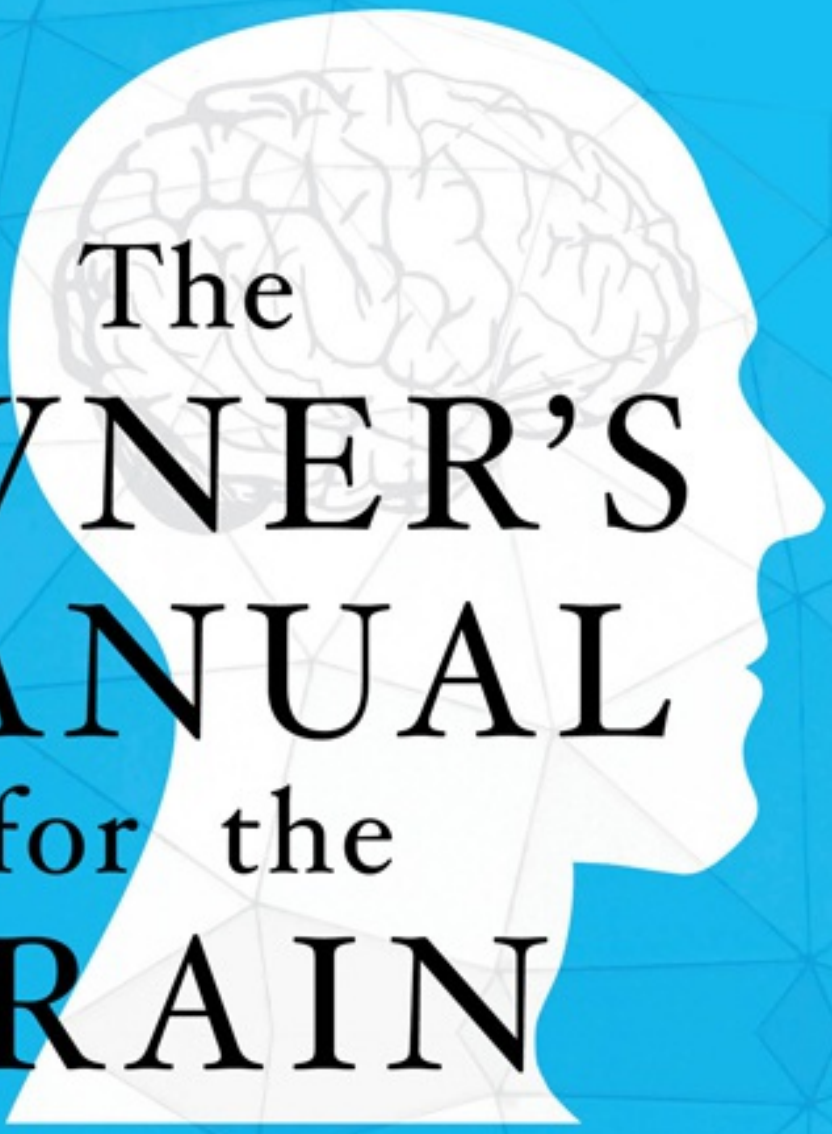
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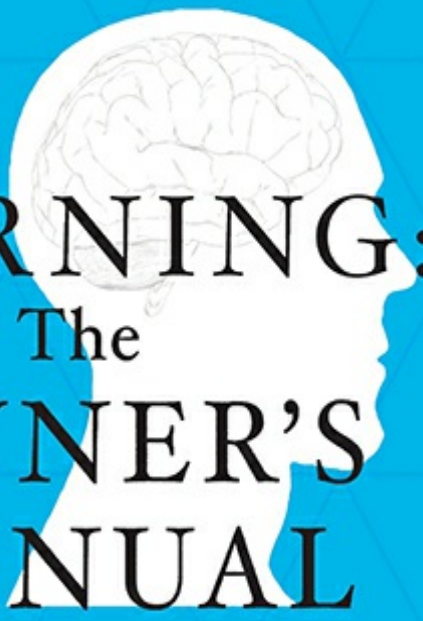


The OWNER'S MANUAL for the BRAIN

THE ULTIMATE GUIDE TO PEAK MENTAL PERFORMANCE AT ALL AGES

LEARNING

Pierce J. Howard, Ph.D.



LEARNING: The OWNER'S MANUAL

Excerpted from
The Owner's Manual for the Brain

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A Note to the Reader

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How We Learn

Acquiring and Remembering Information

"What sculpture is to a block of marble, education is to the human soul."

—*Joseph Addison*

Learning is memory; memory, learning. Learning entails two processes: acquiring and retaining. Psychologists and educators would call these processes short-term memory and long-term memory. Whether we are learning a telephone number, a chess strategy,

a role in a play, a dance step, or how to recover from a computer mishap, in order to say that we have learned something we must be able to demonstrate that not only have we acquired the knowledge or skill, i.e., that we understand it and can use it properly, but that we also have *retained* that understanding so that we may continue to use it over time. If we learn how to use something but forget soon afterward and must look it up (on the Internet, in a reference book, or from an associate), then we have only done half the job. To completely learn something, we must be able to use it repeatedly and independently. If I must continue to refresh a memory, I have only partially learned it.

A word of clarification is in order: To remember something is not the same thing as to memorize something. To memorize something is not the same thing as to learn something. Memory is used in two senses here. If I learn to play a Bach sonata, that means that I have mastered the notes and can play them for an audience. However, it does *not* mean that I have committed it to memory, or memorized it. Or I might learn to make a souffle without memorizing the ingredients. Or I might learn how to use a complex statistical formula without memorizing its elements. On the other hand, in all three cases, I *might* commit the elements to memory—the note, the ingredients, and the mathematical symbols, so that I am free of the texts that bear them. To memorize is a specific kind of learning goal that does not necessarily entail understanding. I could memorize a Latin quotation and speak it impressively at my next cocktail party without understanding a jot of it. So, the two meanings that we will necessarily modulate between are as follows: to remember how to use, do, or apply something, without regard to whether we need prompting as to the specifics, and to remember all of the details of something without needing any prompting as to the specifics. The first is like conducting Beethoven's Fifth Symphony from a score, while the second is like conducting without the score. In both cases the conductor has learned the piece, but only in the second case have they memorized it. One can learn how to do something, and remember how to do it, without having memorized it.

Another key point to keep in mind with respect to how we use the word *memory* is that it comes in different modes: memory for words (e.g., a poem),

for numbers (e.g., telephone numbers or the times tables), for images (e.g., faces or artworks), for sounds (e.g., specific engine noises or melodies), for movements (e.g., dance steps), for nomenclatures and organizational schemes (e.g., an organization chart or the periodic table of elements), for interpersonal idiosyncrasies (e.g., what motivates different people), and for personal preferences (e.g., things I do and don't like). These eight areas are called talents, or multiple intelligences, and are discussed in more detail in chapter 29.

In this chapter we will focus initially on the mechanics of learning and memory. We will follow this by presenting researchers' recommendations on how to learn most effectively. Because so many findings must be presented, I have sought an organization scheme to help make sense of them. I found such a scheme in the writings of one of the great thinkers of the Renaissance, Rotterdam's Desiderius Erasmus, who wrote in 1512 (in Latin!), "The best memory is based on three important things: namely study, order, and care." Memory expert Joan Minninger (1984) has renamed these three emphases as "rehearse, file and intend." I could paraphrase the two of them as "allow time for practice, find a pattern to help you make the meaning personal, and make up your mind that you really want to remember it." I would change the sequence, however, in order to emphasize the importance of making up your mind that you in fact want to remember something. That comes first—when you decide you strongly want to learn and remember something, it behooves you to find a pattern to facilitate memory and then to practice it repeatedly. Intend, file, and rehearse.

Here is an example from a common situation: You meet someone and really want to remember their name, for whatever reason (possible romantic connection, political ally, someone to recruit for a service project, and so forth). Thus, you *intend* or care to remember their name. Second, you say to yourself, "Her name is Amanda Campbell. What pattern about her suggests Amanda, or Campbell? Well, she has red hair, and the red could be associated with the famous Campbell's soup can. She also has noticeable hair on her upper lip, making her look somewhat manly. So, A-MAN-da Campbell." You then picture a can of Campbell's soup with her face on it

with a pronounced mustache. You make up your mind to say her name several more times that evening. Each time you say it silently, you picture the soup can. Eventually, when you see her, you see the soup can and the name comes to mind. Associating the name with the soup can and mustache is the *file* or *order* phase of the process, and repeating the name in association with the image is the *rehearse* or *study* phase.

After I present the mechanics of learning and memory, you will find the remainder of the chapter organized in these three groupings:

- Strategies for intending to, or wanting to, or caring about remembering
- Strategies for organizing, associating, or filing the new learning in some meaningful way
- Strategies for practicing, rehearsing, or studying what you have successfully put into short-term memory so that it will transfer into long-term memory

Note: In earlier editions of this book I included a section on so-called learning styles. However, a report in *Psychological Science in the Public Interest* in December of 2008 called into question the usefulness of learning styles. According to the "meshing" hypothesis, when students of a certain style are taught by a teacher employing that style, the student learns more than students who are taught by a teacher whose style does not mesh with or match the student's. However, according to the authors (Pashler, McDaniel, Rohrer, and Bjork, 2008), "The contrast between the enormous popularity of the learning-styles approach within education and the lack of credible evidence for its utility is, in our opinion, striking and disturbing. If classification of students' learning styles has practical utility, it remains to be demonstrated" (p. 117). They concluded that the desire of the individual student to learn and their effectiveness in pursuit of learning is independent of stylistic differences.

The Mechanics of Memory

Research on memory has taken a significant turn in recent years. Memory used to be regarded as a structure; now it is seen as a process. A memory was thought of as a single unit with an identifiable place of residence somewhere in the brain that could be recalled when necessary. Now a memory is viewed as a reconstruction from many different chunks stored redundantly throughout the brain (see topic 20.2). Bartlett (1932, p. 213) foresaw this development when he wrote:

> Remembering is not the re-excitation of innumerable fixed, lifeless, and fragmentary traces. It is an imaginative reconstruction, or construction, built out of the relation of our attitude towards a whole active mass of organized past reactions or experience, and to a little outstanding detail which commonly appears in image or in language form. It is thus hardly ever really exact, even in the most rudimentary cases of rote recapitulation, and it is not at all important that it should be so.

This new view of memory was brought dramatically to the public's awareness after John Dean's testimony at the Watergate hearings. Viewers were initially impressed with Dean's avowed excellent memory for detail. But when his testimony was later compared with accurate records of conversations, viewers (and Dean himself) were flabbergasted to learn that most of his testimony was at best flawed and at worst made up.

Bolles (1988, p. 23) describes the process of memory this way: "We remember what we understand; we understand only what we pay attention to; we pay attention to what we want." In other words, experience arouses emotion, which fixes attention and leads to understanding and insight, which results in memory. Bolles continues: "Attention is like digestion. We do not store the food we eat; we break it down so that it becomes part of our body. Attention selects parts of experience and uses [them] to nourish our memories. We do not store this experience, we use it. Of course, we eat many things that we do not digest and we also experience many things without paying them any attention" (p. 183).

Defining Memory

Memory is learning that sticks. Before memory, potential new learnings linger briefly in a kind of "scratchpad" about the size of a postage stamp that is located in the right prefrontal cortex, above the right eye and about one inch behind the forehead. This working-memory area can hold the proverbial seven plus or minus two bits of information (see topic 20.19) until such time as we decide to make a permanent record of it. When we decide to remember it, new synapses form, old synapses are strengthened, or both. These new or strengthened connections are the new learning. The synaptic connections are the molecular equivalent of a chunk of newly learned material, such as a telephone number. Initially, as we learn, a protein called *kinase C* (PKC) is deposited among certain hippocampal neurons, according to Daniel Alkon of the Marine Biological Laboratory, Woods Hole, Massachusetts. (*Note:* Neuroscientist Aryeh Routtenberg of Northwestern University has put forth a rival explanation, in which new proteins are not what form the new synapse, but rather a reshaping of existing ones. Watch for more on this.) Apparently, kinase C causes the branches of the brain cells to narrow. When they have narrowed and formed new synapses, learning has occurred. Unless the learning is converted into long-term memory, however, it will disappear, just as new muscle fiber will break down if it is not used. Again, we must use it or lose it.

Researchers on a team drawn from both the University of Texas Medical School at Houston and the University of Houston have reported the discovery of *transforming growth factor B* (TGF-B), a protein that works as a kind of congealing agent to solidify new synapses (*Science,* March 1997). In research with snails, the Texas team discovered that the presence of TGF-B was associated with substantially higher electrical charges, hence stronger responses to stimuli. The discovery of this protein shows that, in addition to "use it or lose it," we also need the proper chemical makeup. Watch this line of research; it could well lead to breakthroughs in the treatment of Alzheimer's disease and other memory disorders.

With continued use, the hippocampal cells extend the storage of the new

learning to the cerebral cortex, which then becomes the primary location of long-term storage and retrieval (see appendix A). When a new learning chunk reaches the cerebral cortex, it apparently is stored for the long term. Larry Squire, of the University of California, San Diego, describes the hippocampus as a kind of broker that binds memory until the cortex takes over and becomes its handler. And Gazzaniga (1988) reports that memory occurs not just in the brain but throughout the nervous system. In animal research, animals lacking a hippocampus can remember remote items but not recent items, whereas animals with intact hippocampi remember recent items better than remote items, which is the normal condition. Anders Bjorklund of the University of Lund in Sweden has demonstrated that aging rats with deteriorated hippocampi are unable to learn new skills, yet they are able to learn and remember after receiving transplants of good hippocampal cells from young rats.

What we know about memory formation is shown in figure 20.1. The perception of an event triggers activity at the synapse. The quality of this activity depends on the person's readiness (fatigue, stress, medication) and volition (intention to remember, emotional arousal). Assuming that the person is ready and waiting to capture the event as a memory, protein kinase C is released and settles around the synapse, thus forming the basis of memory (or, as Routtenberg suggests, existing proteins are reshaped). With subsequent recall and practice, the new connection strengthens.

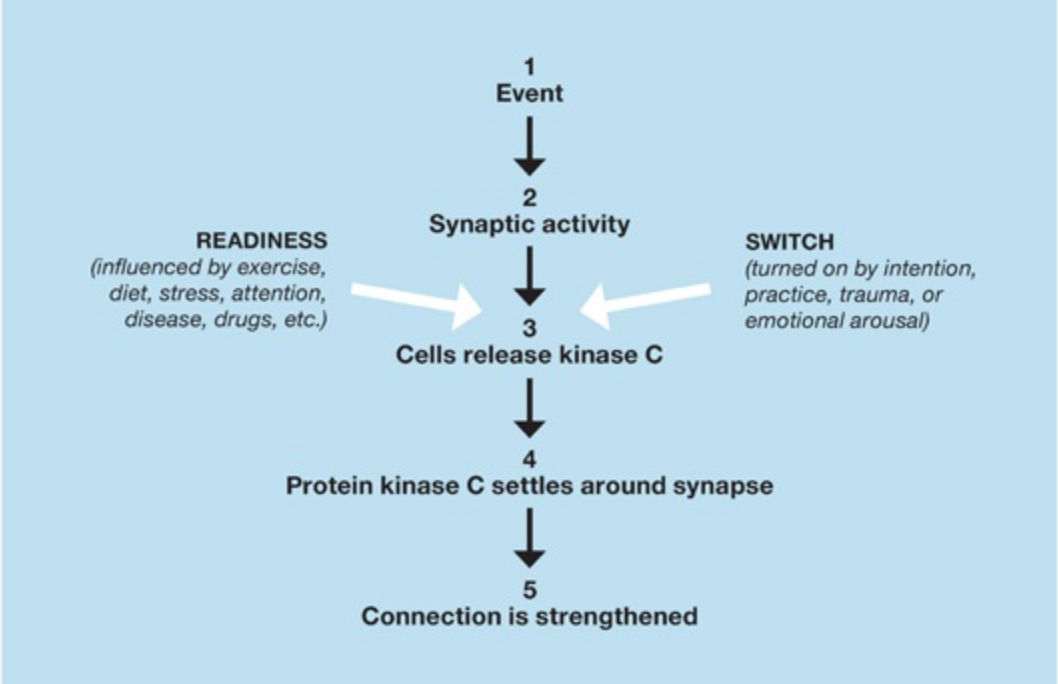


Figure 20.1. The Process of Memory Formation

Memory appears to be fully developed by eight years of age. At that point, we remember an average of one bit of information out of every 100 we receive. There is some debate about the relationship of memory to IQ, but I agree with those who hold that they are apparently unrelated. As I read the research, I am convinced that if memory and IQ appear to be directly related, it is because those with higher IQs usually try to acquire more learning than those with lower IQs. In a competition between adult humans and five-year-old rhesus monkeys, the University of Texas Health Science Center in Houston reported that after viewing a series of slides, humans and monkeys both got 86 percent right on a 10-item test in which they were shown the slides with new slides mixed in and asked to press a lever when they recognized a familiar slide. One of the reasons that people who score high on conventional IQ tests also have excellent memories is that conventional IQ tests include so many questions whose correct answers rely on a good memory. A purer IQ test would separate memory as just one variable. Of course, this all depends on how one defines intelligence. My attempt to define a comprehensive, integrated view of intelligence is presented in chapter 29.

Remember that it is not sufficient to learn a new concept, skill, or body of information; you must convert it into long-term memory. In other words, if you take the time to read a book or article, say, on how to be a better listener, you probably will not remember the skills or concepts unless you practice one or more of the three strategies described in topic 20.4.

A Note on Genetics and Learning

Researchers are discovering specific genes that affect various aspects of the learning process (*APA Monitor,* May 1997, p. 29). For example, the gene named *Linott* is associated with the ability to form a new learning; fruit flies (*Drosophila*) whose Linott gene is missing are unable to form new learnings, but flies whose Linott was removed in infancy are able to learn new tasks when the gene is restored in adulthood. The gene called *Creb* is associated with the ability to retain a new learning over the long haul—that is, to store it in long-term memory. Fruit flies with Linott but without Creb can form new learnings but cannot remember them. Intensive research is under way for possible applications to human learners.

TOPIC 20.1 The Three Stages of Memory Formation

Forming a chunk of memory is like making a photograph. Regard photography as a three-stage process: (1) capturing the image on light-sensitive film, (2) developing the film with chemicals, (3) fixing the image permanently with chemicals. A similar process happens in memory-chunk formation: capturing the chunk (immediate memory), developing it (short-term memory), and fixing it (long-term memory).

Immediate memory is a kind of buffer area that can hold thousands of pieces of data for two seconds or less. For example, when you look up a telephone number that you've never seen before, you'll forget it a few seconds later unless you keep repeating it. New information will push out old unless the old is paid attention to.

Short-term memory—often referred to now as *working memory*—appears to function in the hippocampus as a kind of broker that selects chunks of data to remember. A chunk is defined as an unfamiliar array of seven (plus or minus two) pieces, or bits, of information—for example, a seven-digit telephone number, a new word such as *phlyxma* (I made this up!), or a new definition composed of familiar words. George Miller (1956), in a classic article in *Psychological Review,* first identified the fact that people learn most efficiently in units of seven plus or minus two. He calls it the "magical number seven." Groups of seven occur throughout literature and history (the Seven Wonders of the World, the Seven Mortal Sins, the Seven Virtues). The Australian aborigines have only seven words for numbers, equivalent to one, two, three, four, five, six, and seven. Another word means simply "many," or more than seven. It is perhaps because the aborigines have little or no need for long-term memory that they recall only what is reinforced daily. The word for "three" surely would occur every day, or at least every other day, whereas a word for "sixty-three" wouldn't get a chance to be reinforced every two days. Therefore, "three" would remain in short-term memory, but "sixty-three" would disappear and have to be reinvented.

More recently, Nelson Cowan has modified Miller's "seven plus or minus two" to the round number of four (*Trends in Cognitive Science,* March 1998, p. 77). Cowan points out that some chunks are more easily assimilated than others. For example, easily pronounced nonsense words like "wyk" are more easily assimilated than hard-to-pronounce cousins like "wcxik." Cowan urges that four chunks (plus or minus two) are a more realistic target than Miller's seven.

Decision theorist Herbert Simon says that it takes about eight seconds of attention to add one new chunk to short-term memory. Once a chunk has been completely mastered, it becomes a bit and can then be combined with other bits to become a new chunk. In other words, a new chunk loses its identity as a chunk after it becomes second nature to us. Chunks become bits, just as images on film become printable negatives after developing.

Long-term memory appears to be located in the cerebral cortex. Apparently, hippocampal short-term memory communicates with the cortex

through what we call simple human will or effort; over time, it establishes chunks in long-term storage. Using a device that measures blood flow, Henry Holcomb, a memory researcher in Johns Hopkins University's Department of Radiology, has determined that the memory for a new motor skill takes five to six hours to move from temporary storage in the front of the brain to permanent storage in the rear of the brain. Attempting to learn another new skill before this five- to six-hour period is up will cause problems for the prior learning. Holcomb recommends that new learnings be followed by more familiar, routine activity. Much more research is required before we know if this principle also applies to nonmotor memory.

A key to the formation of long-term memory is the level of the neurotransmitters epinephrine and norepinephrine. James McGaugh, a psychobiologist at the University of California, Irvine, showed that rats with low epinephrine levels had poor recall ability, but that booster shots of epinephrine after they had learned something improved their retention. He further found that injecting older rats after they had learned a maze improved their memory. Larry Stein, also at Irvine, shocked rats when they stepped off a platform that was surrounded by water. Weeks later, when the rats were put back on the platform, they remembered and didn't step off. However, when he blocked their norepinephrine, he found that although they could *learn* not to step off, they couldn't *remember,* and they stepped off into repeated shocks. When we have a strong experience, norepinephrine tells the brain to print it, and we hang onto the memory. Apparently, trivial experiences, about which we don't get juiced up, are lost. Blocking norepinephrine prevents us from remembering new information. This is why some people with amnesia can remember distant events but not recent ones.

Epinephrine and norepinephrine are released by the adrenal medulla when the body is subjected to physical or emotional stress. In addition to increasing blood flow, this release causes extra glucose production. The rate of glucose breakdown is a measure of cortical activity. So although you can relax when you are reading, you need to put in a little sweat equity (known as grunting and groaning) in order to convert what you learn into long-term memory.

We acquire one or two bits of information per second during concentrated

study; by midlife we have acquired roughly 10^9 bits. Our average brain capacity is 2.8×10^{20}, or approximately 10 million volumes (books) of 1,000 pages each. This outrageous capacity mandates humility. I've heard people lament that they couldn't learn anymore, that their "brain is full." Yeah, right! There is no way that their brain is full. They have simply reached a point of fatigue and need a break for things to settle. Then, just as the body yearns for more once the last meal has been digested, we are always ready to learn more. I've never met the person who has reached the limits of his or her capacity to learn. I *have,* however, met plenty of folks who have quit learning.

Daniel Alkon (1992, p. 208) writes: "Once a memory link is formed, there is a short period of perhaps hours to days during which the responsible cellular changes can reverse. Then the cellular changes become permanent." In other words, if we fail to review the learning, it will probably disappear. Once the memory or learning has become firmly established, however, "the old memory cannot be erased. Instead, to modify the meaning of the older memory, new memories must be added." As a bleak testimony to the persistence of memory, Alkon laments that memories of early painful and intense abuse are doomed to be permanent. He does not foresee any surgical, pharmacological, or psychotherapeutic cure. Instead, he finds that victims must comfort themselves with three common strategies for avoiding such memories: compulsive behavior, fantasizing, or dulling the senses (p. 213). More recently, James McGaugh, director of the Center for Neurobiology of Learning and Memory at the University of California, Irvine, has found that propranolol appears to be helpful in softening the effects of traumatic memories that keep one awake nights. It doesn't erase the memory, but rather tones it down.

Forget about forgetting: life is a constant struggle of new learning that strives to coexist with the old. Sometimes it appears to us that old memories have been lost, but Alkon points out that "when they are forgotten, the records are not erased but inhibited" (p. 209). Further, he suggests that "the brain is not like a computer that can be reprogrammed after the deletion of old programs. The new programs have to be reconciled with the old. . . .

Whatever pharmacological tools we can devise to facilitate remembering, forgetting, and learning anew, they will not replace the memory banks themselves, or the steps by which they are acquired" (pp. 224–225). Because of this persistence of memory (remember Salvador Dali's "wilting watch"?), some of us will succumb to its familiar voice and give up on new learning.

Stanford University Psychiatry Professor Emeritus Karl Pribram writes of the holographic structure of long-term memory. Each memory seems to be stored throughout the brain, rather than in a single confined location. Apparently, memories hook onto related networks of other memories, so that, for example, redheads are all somehow loosely tied together in your storage, and you can dump out a long list of redheads upon request. These networks become diffuse and interdependent. Neal Cohen, an associate professor at the University of Illinois at Urbana's Beckman Institute, trained rats to learn a maze, then operated on them. If less than one-fifth of the cortex was removed, regardless of where it came from, the rats exhibited no memory loss. If more than one-fifth of the cortex was removed, a proportional loss of memory occurred. So there appears to be no one location within the cortex for memory storage; instead, each memory seems to have an extensive set of backups.

Applications

❶ After a learning episode of an hour or so, take a break and do something to pump up your epinephrine levels: walk about, do isometrics, climb some stairs, do laundry, move some boxes—anything that will generate epinephrine and norepinephrine to help fix the memory. Then go back and review the old material before going on to something new.

❷ Making the effort to reorganize new material you've read or heard about is, in itself, a form of stress that will help you to convert the material to long-term memory.

❸ Take notes on material you wish to remember. *(Contributed by Rick*

Bradley)

❹ In order to retrieve inhibited memories—ones you know are there but can't find—try some method that "uninhibits" the mind, such as hypnosis, relaxation exercises, free-association techniques, or visualization. Try to think of a possible cue that would be associated with the inaccessible memory. For example, if you can't remember someone's name from last night's party, focus on what she was wearing, drinking, talking about, her hair style, where you were standing or sitting with her, who else joined your conversation, and so forth. The act of pulling in all these cues is likely to bring with them the person's name. In her novel *Déjà Dead*, author Kathy Reichs suggests leaving a recall effort when stuck, and clearing the slate with something unrelated:

> I punched in the code for the security system, but in my building excitement I got the numbers wrong and had to start over. After messing up a second time, I stopped, closed my eyes, and recited every word of "I Wonder What the King Is Doing Tonight." Clear the mind with an exercise in trivia. It was a trick I'd learned in grad school, and, as usual, it worked. The time-out in Camelot helped me reestablish control. I entered the code without a slip, and left the apartment [p. 140].

❺ Try to organize your day so that new learnings occur at one of three times: shortly after first waking, shortly before sleeping, and approximately halfway in between. Caution: Remember that exactly halfway between waking and sleep onset is the low point in your circadian rhythm, so you'll be better off timing the new learning a couple of hours before or after that point. For example, if I rise at 7:00 A.M. and retire at 11:00 P.M., my low point—and a good time for a nap—would be around 3:00 P.M. New learnings could be timed for around 8:00 A.M., 1:30 P.M. (or 4:30 P.M.), and 9:00 or 10:00 P.M., depending on when the afternoon session occurred.

TOPIC 20.2 Memory Slip-Ups as a Two-Edged Sword

Not all memory slip-ups are to be considered problematic. Memory researcher Daniel L. Schacter of Harvard has identified (1999) seven so-called "sins" of memory—shortcomings of an otherwise powerful record of the past:

- *Transience.* Some memories grow less accessible over time.
- *Absent-mindedness.* Some memories were processed casually and never took root.
- *Blocking.* Temporary unavailability of otherwise stored memory.
- *Misattribution.* Naming the wrong source for an idea or memory.
- *Suggestibility.* Allowing a leading question or comment to establish a memory-like content as real.
- *Bias.* Allowing present views to distort older content.
- *Persistence.* What we would forget, we can't.

The first three involve kinds of forgetting, the second three involve inaccuracies, and the final one involves memory being too strong in the mind. Schacter makes the case that not all memory "faults" are weaknesses of the memory system that evolution overlooked; rather, they are strengths that have adaptive value, even though at times they can be pesky. Consider:

- *Transience.* What if we remembered absolutely everything, even after it was no longer useful or enjoyable?
- *Absent-mindedness.* What if we didn't have to focus and work at remembering, and our minds were like flypaper, and we remembered everything we encountered?
- *Blocking.* What if we had constant access to everything conceivably related to the issue at hand and were flooded with data?
- *Misattribution.* What if we remembered all the peripheral information

related to a core memory? Typically all we need is the core, not the context. Socially, I need to remember the joke, not the person I learned it from.

- *Suggestibility.* Often we need to know only the gist, not the grist. We allow ourselves sometimes to be led to recalling more detail than we should because it enhances our "credibility."
- *Bias.* Currently held schemas serve to help us organize information, and the more compatible past information is with current schemas, the better we feel about ourselves—so it is natural to aid the past in fitting the present.
- *Persistence.* What if we too easily forgot traumatic events and were daily doomed to approach trauma-producing situations with no sense of forewarning?

Application

❶ Accept faulty memory not as a limitation but as providing a service. Understand that, just like food, memories are often present when we neither need nor want them. React with a sense of humor when otherwise useful memory "failings" play in your field.

TOPIC 20.3 The Two Kinds of Memory Chunks

Joseph LeDoux (2002) summarizes research on the kinds of memory by identifying two large families: declarative and nondeclarative. *Declarative* memories are memories that you can express in a declarative sentence: "I spent last weekend in the mountains," "Montpelier is the capital of Vermont." Declarative memory chunks, also known as *explicit* memory, come in two kinds: episodic and semantic. The weekend-in-the-mountains example above is episodic, the Montpelier sentence semantic. *Episodic* deals with experiences and events; *semantic* deals with facts

(names, dates, places). Both kinds of declarative memories are associated primarily with the hippocampus and are not specific to any domain of knowledge (visual, kinesthetic, mathematical, etc.). *Nondeclarative* memory chunks, also known as *implicit* or *procedural* memory, involve routines or skills that cannot be captured by a declarative sentence. Examples are how to ride a bicycle, how to sing properly, how to form a grammatically correct sentence, and so forth. These nondeclarative memories are not restricted to the hippocampus, and they are heavily associated with neural processes in the sections of the brain that house their knowledge domain. LeDoux points out that nondeclarative memory doesn't require conscious recall (for example, a melody or a tennis serve) and works within the confines of a specific domain (e.g., musical, linguistic, kinesthetic), whereas declarative memories are formed independent of specific domains (e.g., where you vacationed last summer, the name of your neighbors, telephone numbers). To help keep these different kinds of memory straight, refer to figure 20.2.

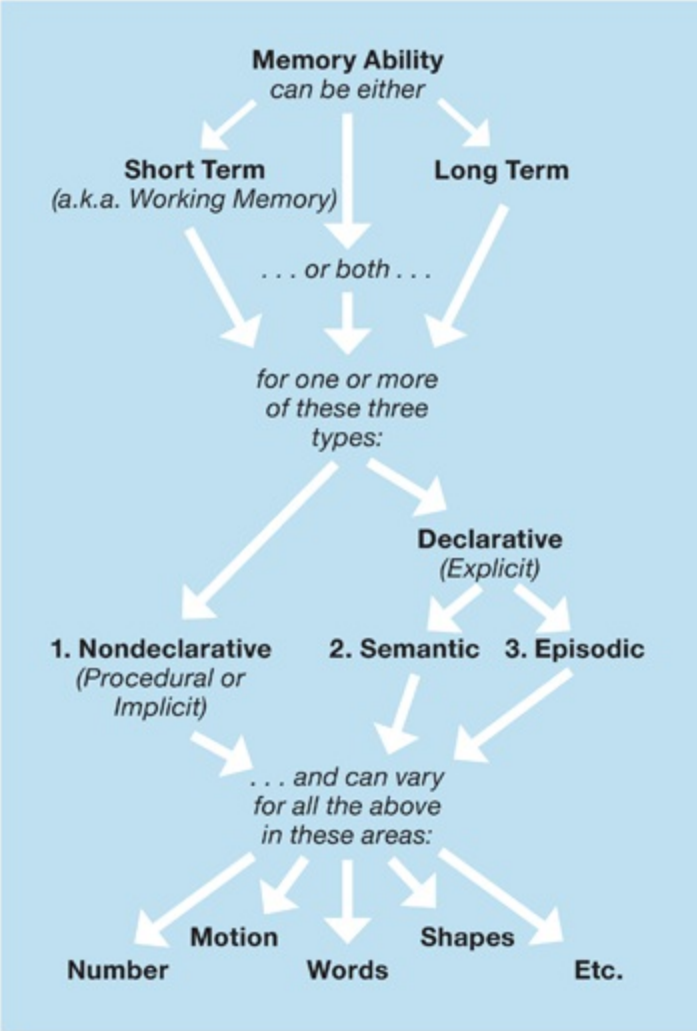


Figure 20.2. A Map of the Kinds of Memory Ability

Skill learning is associated primarily with the limbic (animal) brain, whereas fact learning is primarily associated with the cerebral cortex, which develops after the limbic area does. Perhaps this is why we can't remember much from the first several years of life—why it is easier to remember how to walk, but not how to say a word. Interestingly, damage to the hippocampus (see appendix A) prevents learning of new facts but allows learning of new skills.

Application

❶ It is possible that you have more strength in one kind of memory unit than

in another. If so, emphasize your strengths rather than regretting your weakness. I am sure that my skill (visual-spatial) memory is superior to my fact (language) memory. So I should abandon the frustrating pastime of trying to keep my foreign language ability up and enjoy my ability to learn to play new musical instruments.

TOPIC 20.4 An Overview of the Three Strategies for Learning and Remembering

Earlier in this chapter we said that we would describe the mechanics of memory and learning, followed by a presentation of suggestions for intending, organizing, and practicing for learning. In this topic I present an overview of these three kinds of strategies, in the event that you would like to get a better sense of these three strategies before going into more depth. After this overview, you will find three distinct groupings of effective learning strategies based on extensive educational and psychological research. If you would like to review the contents of each of these three areas, simply refer back to the table of contents for chapter 20, where you will find all of the topic titles for intend, organize, and rehearse.

Applications

❶ Here are some ways to apply the *intend* strategy:

- Before reading an article or book, "pre-read" it by examining the section headings, pictures, charts, graphs, figures, appendixes, and bibliography to get a feeling for how it is laid out and what it covers. This will serve as a kind of advance organizer that will make the reading more meaningful.
- Before taking a course or workshop, do all you can to be ready to receive the material: read the course syllabus, outline, agenda, handouts, and bibliography; read relevant material suggested by a

librarian, the instructor, the bibliography, graduates of the course, or common sense. Contact past participants to hear what they learned.

- Consciously decide to remember something; then select a way to file it (see application 2 below). D. J. Herrmann (1991) provides many good suggestions in his book *Super Memory: A Quick-Action Program for Memory Improvement.* His approach is not as technical as those of Buzan (1991) and Lorayne and Lucas (1974).
- Once you've decided to memorize information, one way to show your intention is to chunk it (see topic 20.19) and learn the chunks. Divide and conquer.
- Understand and practice the concept of state dependence described in topic 20.35.

❷ Here are some ways to apply the *file* strategy:

- Make a flowchart, Pareto chart (see topic 26.3), or any other kind of graphic that structures what you've learned in a way that's meaningful to you.
- Using self-sticking notes or a material like flannel board, write out single chunks of what you've learned on their own sheets. Then arrange the chunks on a wall in a way that makes sense to you. Restudy the arrangement from time to time and rearrange the notes as needed. When you've fixed the organization the way you like it, make a flowchart or some other kind of chart or outline and put it away for easy review or retrieval. Keep it in your portable notebook for frequent rehearsal.
- Describe the person or object you want to remember in a way that evokes the name of the object. For example, you might associate the name Ann Woodward with this description: "She who keeps the extra timber for repairs to Green Gables."
- Substitute words (perhaps with rhymes) as an aid to remembering a

name. Try to make the words graphically visual. For example, if Harvey Darrow has bad acne, associate the name with the substitutes "larvae barrow" while visualizing a wheelbarrow containing dirt filled with larvae (acne). At a party, if you want to remember the name Ted Miller, and Ted is extremely lacking in personality, remember him as the Dead Miller. I invite folks who reverse my first and last names to remember my name as rhyming with the "fierce coward" (Pierce Howard). See *The Memory Book* (Lorayne and Lucas, 1974) and *Use Your Perfect Memory* (Buzan, 1991) for many ideas on visualization techniques for memory. These authors remind us that our memory for images is better than our memory for words, and our memory for concrete words is better than our memory for abstract words.

- Lorayne and Lucas (1974) recommend another technique called *linking,* which is a way to remember a list of things. If you need to stop by the grocery store to pick up milk, bread, hose, and shrimp, link each word to the next one on the list by some exaggerated visual connection. For example, a huge carton of milk has a loaf of bread for a stopper, with a pair of hose connected to the bread to pull it out in order to pour the milk into a saucepan to boil the shrimp. Once you've made these admittedly outlandish linking associations, all you have to remember is the first image—the big bottle of milk—and the rest follows.
- Use the peg-word technique, described in topic 20.25, application 2. The peg-word technique is actually a variation on the *loci* technique of Simonides, the ancient Greek orator. Simonides associated parts of a speech with parts of familiar places (*loci*); for example, each spot in a familiar walkway or building would be associated with a paragraph or subtopic of the speech.
- To remember a number, such as a telephone number, substitute the phonetic consonant equivalents for the numbers and fill in with vowels to make up words. To substitute consonants, try these possibilities:

1 = *d* or *t* or *th* (one vertical stroke)

2 = *n* (two vertical strokes)

3 = *m* (three vertical strokes)

4 = *r* (last letter of the sound of four)

5 = *L* (Roman numeral for 500)

6 = *j,* soft *g, sh,* or *ch* (*J* and *6* are mirror images; the others sound like the *s* or *x*)

7 = *k,* hard *g,* or hard *c* (angular, like a *7; g* and *c* sound like *k*)

8 = *f, v,* or *ph* (cursive *f* looks like an *8; v* and *ph* sound like *f*)

9 = *b* or *p* (*b* looks like an upside-down *9 and p* like a backward *9; b* and *p* sound alike: they are labial consonants)

0 = *z, s,* or soft *c* (first letter in *zero*)

To remember the telephone number for our favorite Indian restaurant, I came up with Lub Duk Tiki-Ba, or 591-7179 (LBD-KTKB). Leave out the vowels and substitute numbers for consonants according to the above list (or think up your own). See Lorayne and Lucas (1974), Buzan (1991), and Minninger (1984) for more examples. Try to create outrageous, gruesome, or bawdy images—they're easier to recall and can be your private joke on the world.

❸ Here are some ways to apply the *rehearse* strategy:

- Obtain or create the material on CD or audiotape and review it while driving, jogging, walking, or riding the bus.
- Create a tickle file. Assign a file folder for each month, week, or day and insert notes you want to review in the appropriate folder.
- While reading, use a highlighter or pen to note sections for review; then periodically review the highlighted sections.
- When you are idle (stopped at a red light, walking, and so on), recall

recently memorized material and rehearse it. Review this material with a walking or jogging partner.

- Make a set of flash cards of the steps in a process or some other sequential list of items you want to remember, with the correct sequence of each card indicated on the back side. Shuffle the cards and sort them.
- For many additional suggestions, information, and training opportunities, get on the mailing list of The Buzan Centre of Palm Beach Inc., 415 Federal Highway, Lake Park, Florida 33403 (800-964-6362 or 800-Y-MINDMAP, www.mind-map.com).

Strategies for How We Might *Intend* to Learn

TOPIC 20.5 Advance Organizers

Students tend to learn more when they are given some warning about what they are to learn. Perhaps this brings relevant schemas into the foreground or at least prepares them to put forth an appropriate effort to form new ones. Techniques used to alert learners about the nature of an upcoming learning episode are called *advance organizers* because they help them to call up relevant schemas in preparation for learning.

Applications

❶ Send out preliminary reading materials.

❷ Provide an outline or agenda of the learning experience both in advance of the session and at the beginning of the session.

❸ Review the objectives at the beginning of the session.

❹ Tell people what you are getting ready to do. Abruptly moving into an activity is disturbing to many people.

❺ Before class, have the attendees meet with their supervisor or team members to agree on expectations.

❻ At the beginning of the session, give the participants some kind of big-picture overview of the material to be covered; this provides a map for the terrain.

❼ Ask the participants what their expectations are. *(Contributed by Jane Howard)*

❽ Choose appropriate textbooks (see the applications for topic 20.8).

❾ In chapter 12 we learned about the Mozart effect, or how playing Mozart-type music prepares the mind for spatial reasoning tasks. That is a kind of advance organizer.

TOPIC 20.6 Atmosphere

Research has identified a long list of learning atmosphere variables, each of which suggests its own applications. See more on workplace design in chapter 10.

Applications

❶ Faber Birren, in *Color and Human Response* (1978a), has suggested the many effects of color on people. See topic 10.9 for a listing of these effects.

❷ Ensure abundant light, especially at the beginning of a session, for those who may not be fully awake.

❸ Remember that a moderate amount of background noise (so-called white noise) is helpful for concentration. If the room is too quiet when participants are working silently at their seats, you can run the fan of an overhead projector *(contributed by Jane Howard)*. Paradoxically, white noise can also be helpful in eliminating distractions when you are trying to fall asleep or

stay asleep. An air filter with an audible fan works well *(added by Helen Hyams).*

❹ You can take advantage of the knowledge that arousal (both limbic and cortical) is associated with a warmer brain, pleasant moods with a cooler brain. Robert Zajonc, of the University of Michigan, has found that slow, minor-key music warms the brain, and breathing through the nose cools the brain (Izard, Kagan, and Zajonc, 1984).

❺ Provide places and opportunities for adult learners to contact their offices. Also have phone lines or phone jacks available for those who need to check e-mail, as well as outlets for recharging cell phones and laptops.

❻ Avoid serving high-glycemic carbohydrate foods (sugary cookies and pastries) for snacks; they produce a pleasant mood and subsequent sleepiness. Choose proteins and low-glycemic carbohydrate foods like fruits, vegetables, whole-grain crackers or breads, and nonfat dips, all of which are better for mental activity. Supply juices, bottled water, and diet sodas in addition to regular sugared colas. See more about nutrition and mood at topic 14.8.

❼ Make sure that ample caffeine-free beverages are available to prevent overarousal, which makes concentration difficult. Many hotels that host seminars fail to provide enough decaffeinated beverage options.

❽ Encourage participants to sit in a different place after each break; research indicates that this improves participation and freshens the participants' perspective.

❾ Allow 50 square feet per person in the classroom; less is stressful.

❿ Plan the lighting in the room carefully when you are using slides or an overhead projector. Develop alternative presentation methods if the room must be darkened too much.

⓫ An article on class size in *Scientific American* (November 2001) concluded that class size has no consistent impact on student learning, with

the exception of smaller class size being associated with benefits for minority students in the early grades.

TOPIC 20.7 Developing Prestige

In their research, Caine and Caine (1991) found that students perform better when they perceive the teacher to be prestigious. They further found that this prestige comes primarily from two perceptions: that the teacher has expertise and that she or he is caring. Expertise is assumed from the appearance that the teacher has mastered the subject, is not dependent on notes (except to help in sticking to the subject), and has practiced what is being preached. Caring is assumed from the appearance that the teacher accepts and values each student as a human being.

Applications

❶ Practice the applications in topics 22.10 and 22.12.

❷ Try visualizing the class process in much the same way that a skier visualizes a downhill sequence before jumping off. Keep notes on potential problems you spot while visualizing, then solve them after you finish.

❸ Try a dry run in which you move through the class process rapidly, again keeping notes on potential problems.

❹ Try putting notes on the borders of your transparencies to avoid the distraction of looking down at notes in your hand.

❺ Try out the lesson plan first on a test group (office mates, your family, a group of employees, or even paid guinea pigs). Have them critique you or simply serve as a live test audience.

❻ Arrive early and greet people by name; don't rush away as soon as the lesson is over.

❼ During breaks, mix and mingle.

❽ Lightly pencil your notes onto blank flip-chart pages before class. The notes will go unnoticed by participants, and you'll be seen as well versed in your subject. *(Contributed by Rick Bradley)*

❾ When seeking input from a group, capture their responses on a flip chart or transparency. *(Contributed by Rick Bradley)*

❿ Acknowledge input from the group. *(Contributed by Rick Bradley)*

⓫ Work hard to understand your audience and their issues and concerns. Use this understanding to build class outlines. Use real-life examples they can relate to.

⓬ If you have been brought into an organization as an outside expert or guest, have someone from the organization introduce you to the group. *(Contributed by Jane Howard)*

⓭ Display or mention licenses, certificates, apprenticeships, degrees, and awards.

⓮ Whenever possible, bring current information from a recent newspaper, television show, journal, or other information source. This contributes to your learners' perception of you as keeping abreast of your field.

⓯ Award-winning professor Charles Brewer of Furman University says that teachers must show a "passion for their discipline, and a passion for sharing what they know about it with their classes. . . . That's what separates gifted teachers from those who merely teach" (*APA Monitor,* January 1994, p. 39).

⓰ Give the class a brief handout that includes a curriculum vitae and other relevant information about you and your qualifications, along with a contact phone number or e-mail address, for later reference. *(Contributed by Helen Hyams)*

TOPIC 20.8 Focus and Attention

Notwithstanding teenagers' claims that they can do homework in front of the television set, the brain cannot focus on more than one stimulus at a time. What may appear to be multitasking, or simultaneous focusing, is in fact a rapid alternation of focus. The more routine a stimulus is, the less it interferes with rival stimuli. So if you're listening to the news while driving on the interstate with moderate traffic, you will miss far less of the news than when you are driving around the Place de l'Étoile in Paris trying to maneuver across eight lanes of circular traffic. To underscore this point, University of Toronto physicians Donald Redelmeier and Robert Tibshirani reported that automobile drivers were 4.3 times more likely to have an accident while using a cell phone than when the unit was not in use. They reported that hands-free phone operation provided no safety advantage over hand-held sets (*New England Journal of Medicine,* February 13, 1997). Also, Geoffrey Woodman and Steven Luck, psychologists at the University of Iowa (Iowa City), have offered convincing evidence (in *Nature,* August 26, 1999) that supports the notion that we pay attention to items serially, not in parallel (two or more at a time). Electrophysiological measurements revealed rapid changes in event-related potential as the brains of subjects searched for particular elements in an array.

Much has been made of "information overload" in the 1990s. I don't buy it. Oprah Winfrey was concerned about forgetting the security codes to Harpo Studios in Chicago and about forgetting on Thursday the subject of Tuesday's show. Her producers called and asked if I'd care to come to the show and explain what they were referring to as "Yuppie Alzheimer's." Certainly. I explained that information overload, or Yuppie Alzheimer's, did not exist. There has always been abundant information vying for our attention. The hunter-gatherers who survived and made our existence possible were those who paid attention to the source of berries, seeds, and other nutrients. Can you imagine a gatherer in 10,000 b.c. wandering around a new terrain, finding berries, and *not* making it a point to remember the location? The next day, he'd make a beeline to yesterday's berry source. The

gatherers who mindlessly skipped from bush to tree, from berry to nut, without paying effortful attention to remembering their locations, were doomed, at worst, to languish tomorrow in hunger or, at best, to waste precious time in having to relocate the stash.

So what did I tell Oprah and her viewers? "Stop and smell the roses. If you really want to remember something, make a point of remembering it. Focus, intend, practice." To make my point, I looked at her intensely and said, "I'm going to make a point of remembering exactly what you look like today. I know people will ask me. Well, you are wearing gold knot earrings with three strands woven in a pattern about three-quarters of an inch in diameter. You are wearing a two-piece tan knit suit, with the dress floor length (almost) and the jacket open and three-quarter length." By intending to remember, and by really *focusing* on her attire, I still remember it some 10 years later. And because so many people ask me about the show, I keep recalling it, which further reinforces the memory. Oprah can improve her recall with similar efforts at focused attention with the intention of remembering. It's funny: when we were in school, we made a point of trying to remember. As adults, we casually read or observe without similar efforts at remembering, such as taking notes or reviewing, and then we lament that we are "losing our memory" when we can't remember! For example, an executive reads *The Wall Street Journal* over breakfast, then later in the day tries unsuccessfully to recall the name of a person featured in a news story. She laments: "Oh my! I am getting old. My memory is going." Balderdash. We're expecting results like those of our schooldays without exerting a similar effort. There's something wrong with that picture.

This comes under the Brave New World category. U.S. Air Force researchers attempted to heighten arousal and attention by administering a mild electric current (two milliamperes of direct current for one-half hour) while pilot students were learning to use a visual drone-guidance simulator. This happens to be a major training bottleneck these days. The researchers were in search of anything that might speed the training. To their amazement, this use of transcranial direct current stimulation (TDCS) cut the required training time in half. Don't get too excited—the study (Fields, 2011) must be

replicated and applied to other contexts, and serious ethical issues must be answered, including whether or not such a practice could be permitted on a broad scale without knowing whether long-term adverse consequences are associated with it. Meanwhile, most of us will have to settle for caffeine as a more known quantity for eliciting arousal.

Attention is maximized by learning design elements such as "Handle It!" (topic 20.30) and "Practice" (topic 20.32).

Applications

❶ Avoid playing music if you want the learner to concentrate. My wife and I once attended a workshop together. The leader asked us to complete a worksheet individually and silently. As we began our seat work, the leader started to play some background music—I believe it was a '50s tune. Well, my wife knew every word to that and each succeeding tune, silently sang along with them, and found it impossible to concentrate on the worksheet. The background music became foreground for her.

❷ Don't introduce a new skill on top of a prior one until the prior skill has become routinized. Practice the skills separately until one is mastered; then you may build on it. My daughter understood this well when, at the age of eight, she took Suzuki violin lessons. One day, as I was supervising her practice, she lost patience with my approach and glared at me, saying, "I'll keep my wrist right, or I'll keep my feet right. Take your pick. But don't make me do them both at the same time."

❸ Avoid using your cell phone when the car is in motion. When you must use your phone while driving, inform the other party that you're driving and that you may have to refrain from talking or listening if the traffic gets difficult. Avoid using your phone when you're approaching an intersection or when you're passing or being passed. Use it instead when you're cruising down a highway or major road with moderate traffic. If you're talking on the phone and approach an intersection, simply tell the other party, "Please hold

for a second until I clear this intersection."

❹ Remember, doing two things at once is an illusion; you're actually doing the two things in alternating streams.

❺ If you really want to remember something, stop and pay attention to it. Don't create competing distractions.

TOPIC 20.9 Follow-Up

The best way to ensure that classroom learning will be forgotten is by failing to provide opportunities for follow-up and follow-through. Studies show that a larger portion of the material learned in a classroom setting is retained when the learner or the teacher makes provisions for follow-up.

Applications

❶ Have learners write "goal letters" (e.g., "Here's how I plan to use my new learning from this experience, and what I hope to accomplish") to themselves and turn them in to you; then mail them out several months later. These "letters from the conscience" remind them of what they intended to work on after the training session.

❷ Make sure that, after returning to the job, the learners schedule a conference with their supervisor or team to review their accomplishments and the possibilities for applying their learning on the job.

❸ Develop refresher modules of short duration for students to take periodically.

❹ Hold class reunions.

❺ When using a series of spaced modules, provide homework assignments (practice or reading) between sessions. Review the homework, sharing

successes and failures at the beginning of each session.

❻ Plan during class how each participant will apply new learning to the job—for example, by writing scripts, developing implementation schedules, identifying obstacles to success, or writing personal development plans.

❼ Send out audio- or videotapes or CDs that recap the major points of the training session.

❽ For schoolchildren, suggest to parents how they might follow up classroom learning by at-home applications and exercises. An excellent example of this is the series of CDs developed by Frances Van Voorhis and Joyce Epstein of Johns Hopkins University and presented in their book *School, Family, and Community Partnerships* (2nd ed.).

❾ Duke University homework expert Harris Cooper concludes that homework makes a difference in achievement. He recommends that teachers, parents, and students expect on average ten minutes of homework each day per grade. Accordingly, a third grader would have 30 minutes of homework, while a tenth grader would have 100 minutes. At present, most high school students do less than one hour of homework daily during the school week.

TOPIC 20.10 Positive Expectations

Rosenthal and Jacobson (1968) established that positive expectations tend to yield positive results and negative expectations yield negative results. They call this the *Pygmalion effect,* or the self-fulfilling prophecy. As told by the poet Ovid, Pygmalion was a sculptor who fell in love with his creation, named Galatea, and pleaded to Venus to make her human. Venus acceded.

Applications

❶ Communicate clearly to all students that you have confidence in their

ability to excel.

❷ Communicate to all students your confidence in your own ability to teach effectively.

❸ Communicate to all students your confidence in previous students' successful application of classroom learning to the real world.

❹ Resist the temptation to give up on some students; maintain high expectations for all of them. Remember, you may have some students who've been told all their lives that they're failures, so don't be discouraged if you don't make much of a dent in their self-concept. If enough of us treat them with positive expectations, we increase the chances of their success.

❺ If it is appropriate, mention other groups, classes, or organizations that have successfully completed the program.

❻ For specific suggestions on employing positive expectations in a work context, read Thomas Connellan's *Bringing Out the Best in Others!* (2003).

TOPIC 20.11 Rapport

Researchers, particularly in the field of *neurolinguistic programming* (NLP), have tried to identify why some therapists seem to work magic on clients. They have found that effective therapists tend to establish rapport with clients by matching and pacing—in other words, by mirroring the clients' posture and following their tempo. The research suggests that matching and pacing another person has the effect of establishing rapport and increasing trust and openness.

Applications

❶ When you have a student who seems to be resisting your help, identify the biggest differences between the two of you and see if you can eliminate

some of these differences or at least minimize their effects. For example, get on your knees to talk eye-to-eye with a young child, or slow down your speaking tempo to match a more reserved student.

❷ Move toward a participant who is asking a question or making a comment; establish rapport by getting closer and using eye contact. *(Contributed by Jane Howard)*

TOPIC 20.12 Relaxation

As discussed in topic 20.20, encouraging the learner to feel in control is a major strategy in preventing downshifting—that is, moving from cortical alertness to limbic arousal (stress). Another strategy would be to help learners who are already under stress (for example, those coming into your class after a bad encounter) to "upshift"— move from limbic fight-or-flight arousal into cortical arousal and alertness. When a person comes to your learning experience full of stress, that stress must be relieved before meaningful learning can occur. The primary strategy to use in the classroom is relaxation. Remember, however, that too much relaxation is not conducive to learning. For further consideration of this point, see topic 33.2, which discusses stress and arousal and the Yerkes-Dodson law; see also the comments on accelerated learning in table 20.2.

Applications

❶ Play tapes with sounds of nature—rainstorms, desert winds, the beach, birds—before class, during breaks, or during silent individual work like reading or filling out worksheets. Nature sounds have a way of refocusing a person away from absent stress into the here and now.

❷ Play tapes with simple classical music (Mozart is a good common denominator) before class or during breaks, as a way of helping people refocus. Don't play music during individual work, however.

❸ If you are the teacher, lighten up from time to time in a way that is appropriate for you (e.g., wear funny glasses, a silly hat, and so forth). This keeps students alert and prevents them from downshifting.

❹ If you are a student, practice some of the relaxation techniques described in the applications for topic 33.1.

TOPIC 20.13 Richness

Mark Rosenzweig of the University of California, Berkeley, conducted a classic experiment in which two groups of rats were compared for the impact of environmental richness on brain development. One group was placed in a dull cage, the other in an enriched, "Disneyland" cage. The brains of the highly stimulated rats grew larger and developed denser concentrations of synapses. Other research, including research on humans, has confirmed these findings. See particularly the work of Marian Diamond (1988), also of Berkeley, who concludes that synaptic structures show growth from enriched environments throughout the life span, including old age.

Parallel to Diamond's work, Fred H. Gage and a team of researchers at the Salk Institute for Biological Studies report that enriched environments actually result in increases not only in synaptic complexity but also in the total number of neurons, or brain cells. Gage found a 15 percent increase in brain cells in the mice from enriched cages compared with brain cells in mice from dull cages (*Nature,* April 1997). This research, along with that of William T. Greenough of the University of Illinois, who has shown that aerobic exercise in rats increases the number of neurons (see the information on exercise in chapter 10), demonstrates that with proper management we can *replace* some of the cells lost as a result of natural aging, disease, alcohol, and other brain toxins. Gage has reported that he and a Swedish team have actually observed the generation of new brain cells in humans (*Nature Medicine,* November 1998). This sets the stage for generalizing Greenough's and others' research to humans.

Applications

❶ Put up a variety of posters, corporate and otherwise, such as "The dogs bark, but the caravan moves on," on the walls of the classroom.

❷ As you complete flip-chart diagrams, lists, and so on, tear them off and tape them to the wall for visual reinforcement.

❸ Place games and puzzles around the border of the room and on the students' tables for manipulation during idle moments.

❹ Have a computer around for experimentation with relevant software, or for playing games during breaks.

❺ Hang photographs and artwork in the classroom and nearby hallways.

❻ Have books and newspapers for browsing in the classroom.

❼ Place mirrors in appropriate locations for self-stimulation. Mirrors enhance self-concept among infants and relieve boredom among adults. In one amusing incident, tenants of an office tower complained of long elevator waits. The owners installed mirrors in the elevator waiting area and the complaints disappeared. Preening makes the wait grow shorter!

❽ Post information about local resources such as restaurants and shopping centers. Include maps.

❾ If appropriate, have participants bring in and display some of their own work. As an example, in Bank of America Quality Team meetings, which bring facilitators from across the company together for two- or three-day seminars, participants are asked to show how quality is being visibly promoted in their area. The walls and tables are filled with posters, buttons, banners, T-shirts, memos, job aids, and team pictures. It creates real excitement. *(Contributed by Rick Bradley)*

❿ Use graphics and color on overhead projections, slides, participant

guides, and so on. With PowerPoint presentations, take the time to find the right clip art by searching web resources, not just the gallery provided on your hard drive. *(Contributed by Rick Bradley)*

⓫ Ditch the black flip-chart marker. Use a variety of colors. *(Contributed by Rick Bradley)*

⓬ When you are headed for a particularly boring meeting, make sure to carry along at least three colors of ink pens and colored paper for taking notes. *(Contributed by Rick Bradley)*

⓭ Include extra, relevant reading materials such as articles for participants to read if they finish individual tasks before other people are done. *(Contributed by Jane Howard)*

TOPIC 20.14 Stereotypes and Performance

Claude Steele (1997), a professor in the psychology department at Stanford University, has studied the way stereotypes affect the performance of African Americans in college and the performance of females in the mathematical sciences. He has studied other stereotyped groups as well, but these two are his primary focus. Steele is interested in a particularly puzzling phenomenon: why do capable women and African Americans underperform? Or, expressed another way, why do women who are excellent at mathematics (and who positively identify with the field of mathematics) perform worse in the first two years of college than their SAT and ACT math scores would predict? In a parallel vein, why do African Americans who are high achievers in high school, and who have high SAT and ACT verbal scores, achieve a significantly lower grade point average in the first two years of college than would be predicted by their scores?

Steele hypothesized that these two groups were underperforming because of the effect of *stereotype threat.* Subtly, or not so subtly, he suspected, these two groups were receiving the message that they did not belong. To test his

hypothesis, he administered difficult SAT math questions to capable college women and difficult SAT verbal questions to capable college African Americans. The experimental groups were told that the answers to the questions would in no way reflect on them as a gender or racial group. For example, in order to remove the performance threat associated with stereotyping, students in the experimental groups might be told that the questions were being evaluated for readability. The control groups were allowed to complete the questions with no special instructions; in other words, they answered the questions with any assumptions they made about stereotype threats fully in effect.

The result was that the experimental groups outperformed the control groups and performed at the levels that had been predicted. Steele concluded that teachers and program administrators can remove the barriers to performance in groups affected by stereotype threat by intervening in a way that makes the students feel included, capable, valued, and successful. In a program designed to test his treatment assumptions, Steele and others carried out an intervention at the University of Michigan called "Twenty-First Century," with dramatically successful results. The applications below list specific strategies. Smith and White (2002) have confirmed that stereotype threat is active for American white males when they are told that Asian males are superior in math to whites.

Applications

❶ Teachers and administrators must exhibit optimistic behaviors and attitudes toward students who are subject to stereotype threat (see the discussion of optimism in topic 34.7).

❷ Eliminate the stigma of "remedial" work, preferring instead programs that accept students at their current level of achievement and supportively challenge them to tackle progressively more demanding work.

❸ Through a variety of means, such as posters and conversation,

communicate to students that ability is not a fixed quality. Emphasize that people can incrementally increase their ability.

❹ Affirm that stereotype-threatened groups (women in math courses, African Americans in college honors programs, men participating in interpersonal sensitivity training) belong in their chosen domains by providing role models and other signs of inclusion. Steele emphasizes that in this case, intellectual belonging is substantially more important than social belonging.

❺ Value and employ a variety of approaches to the subject matter.

❻ For students who do not positively relate to the stereotyped subject (for example, women who do not see themselves as mathematicians), emphasize nonjudgmental acceptance of their efforts, preferring a Socratic dialogue to an emphasis on right or wrong answers. Until a pattern of success emerges, prefer acceptance to praise. Above all, build the students' sense of competence, level by level.

TOPIC 20.15 Strategies for Studying

Claire Ellen Weinstein has made lemonade of lemons. When she was a Brooklyn teacher, she found that her father and siblings were inefficient learners. In her efforts to teach them strategies they could use to improve their learning efficiency, she ultimately won a doctorate from the University of Texas at Austin that was based on her assessment of learning strategies and her accompanying developmental recommendations. Students who benefit from her model show remarkable improvements in high school and college course outcomes. The graduation rate of the at-risk students at the University of Texas at Austin who experience her model is 71 percent, compared with 55 percent for the student body at large (*APA Monitor,* April 1998, p. 36). Her instrument, LASSI (Learning and Study Strategies Inventory), is used by more than half the colleges in the United States and has

been translated into more than 30 languages.

The LASSI model is tripartite: skills, will, and self-regulation. The 177-item assessment measures the student learner in 10 areas:

1. Information processing
2. Selection of main ideas
3. Test strategies
4. Attitude
5. Motivation
6. Anxiety
7. Time management
8. Concentration
9. Study aids
10. Self-testing

Application

❶ Obtain a copy of LASSI and assess your learning effectiveness or that of someone close to you. Request a sample from H & H Publishing Company Inc., Clearwater, Florida; phone 800-366-4079 or e-mail your request to hhservice@hhpublishing.com; or visit www.hhpublishing.com and order LASSI in the quantity desired. Their website includes an online sample survey and report.

TOPIC 20.16 Transfer: Applying Classroom Ideas to the Real World

Whenever you teach a theory or concept, give the learners time to apply it to specific situations. Many learners are unable

intellectually or unwilling motivationally to apply an idea to an everyday situation. Detterman and Sternberg (1993) paint a discouraging picture of training in the workplace. They distinguish between *learning* and *transfer of learning.* Learning has occurred when one is able to repeat a new behavior in nearly identical situations close in time to the original learning event. Transfer of learning has occurred when one is able to repeat a new behavior in different kinds of situations that are remote in time—that is, when the learner sees a new *pattern* that fits with the *program* in some way (see topic 21.4). Detterman and Sternberg distinguish *near* and *far* transfer. Near transfer occurs when one repeats a behavior in a similar situation that is remote in time; far transfer occurs when one repeats a behavior in a different situation that is remote in time. Following a thorough review of the literature, they maintain that far transfer is unlikely to occur. Or, as Bransford et al. (2000) put it: "Simply learning to perform procedures, and learning in only a single context, does not promote flexible transfer" (p. 77).

Roughly $100 billion is spent annually on training in the workplace. Detterman and Sternberg estimate that only about 10 percent of that training actually transfers to the workers' jobs. Baldwin and Ford (1988) confirm these numbers; in addition, they state that this 10 percent is only of the "near" variety. An example of near transfer would be learning a counseling skill in a classroom role play involving an employee who repeatedly arrives late to work, then actually using that counseling skill back on the job with an employee who is repeatedly tardy. Applying that skill to a different situation, like that of an employee who never puts his or her tools back in the right place, would be far transfer, and Detterman and Sternberg (1993) say that this just doesn't happen:

> When I [Sternberg] began teaching, I thought it was important to make things as hard as possible for students so they would discover the principles themselves. I thought the discovery of principles was a fundamental skill that students needed to learn and transfer to new situations. Now I view education, even graduate education, as the learning of information. I try to make it as easy for students as

> possible. Where before I was ambiguous about what a good paper was, I now provide examples of the best papers from past classes. Before, I expected students to infer the general conclusion from specific examples. Now, I provide the general conclusion and support it with specific examples. In general, I subscribe to the principle that you should teach people exactly what you want them to learn in a situation as close as possible to the one in which the learning will be applied. I don't count on transfer and I don't try to promote it except by explicitly pointing out where taught skills may apply. . . . There is no good evidence that people produce significant amounts of transfer or that they can be taught to do so. There is, on the other hand, substantial evidence . . .that favors the idea that what people learn are specific examples. Experts are experts because they have learned many more examples than novices. . . . Current evidence suggests all that is necessary to be an expert is time, basic ability, and the opportunity to learn a large body of exemplars by experience [p. 17].
>
> [An expert's] knowledge is so ample and elaborately structured that it is hard to present an expert with a problem that is not already represented therein [p. 174].
>
> People who know a lot about something are not experts because of their ability to transfer but because they know a lot about something [p. 18].
>
> The lesson learned from studies of transfer is that if you want people to learn something, teach it to them. Don't teach them something else and expect them to figure out what you really want them to do [p. 21].

Robert Bjork (1994) extends this thought by commenting that "perceived similarity, or the lack thereof, of new tasks to old tasks is a critical factor in the transfer of training. . . . To the extent feasible, a training program should provide a learned representation that permits the learner to recognize when the knowledge and skills acquired during training are and are not applicable to new problems" (p. 186). Bjork emphasizes that retrieval practice during

the training session is critical in assuring future transfer and retrieval: "Retrieval information becomes more recallable in the future than it would have been without having been accessed. In that sense, the act of retrieval is a 'memory modifier.' . . . As a learning event, in fact, it appears that a successful retrieval can be considerably more potent than an additional study opportunity, particularly in terms of facilitating long-term recall" (p. 188). To relate this to L. A. Hart's (1983) model, retrieval, or transfer, is the act of identifying a pattern that calls for a specific program.

Applications

❶ Use printed, video, or audio examples.

❷ Using your schemas, give examples from your personal experience to illustrate a concept, then ask the learners to generate other examples in small groups, building on their schemas.

❸ If you want the learners to apply a concept or skill you are teaching to some situation far away from the classroom, then think up some likely scenarios and have the learners apply the concept or skill in those settings through role play, small-group work, or individual work.

❹ Whenever possible, use real situations in the classroom for the learners to copy later in other situations. Don't just use generic case studies. In my problem-solving classes, for example, I have students write up a list of problems they'd like help in solving; then we pick the ones my techniques apply to and work on them.

❺ Broad and Newstrom (1992) have found that the manager, the trainer, and the learner each play an important role in transferring learning back to the job. Further, they find that the timing of the involvement of these three roles is different. Although all three should be involved with the learner before, during, and after the learning episode, it is especially critical for the learner to be involved *before* the learning (with preparatory work and advance

organizers), for the manager to be involved *during* the learning (with observation, input, feedback, and support), and for the trainer to be involved *after* the learning (with follow-through practice, support, and feedback).

❻ Bransford and others (2000) describe a variety of new curriculum resources that use technology to bring the outside world into the classroom. This is certainly one way to make sure that classroom learning relates to the outside world! Listed below are several of these projects. Find out more by reading chapter 9 in Bransford's book, which was sponsored by the National Research Council, or by searching on the web for these titles:

- The Voyage of the Mimi (Bank Street College)
- Jasper Woodbury Problem Solving Series (Vanderbilt)
- Global Lab
- Project GLOBE (Global Learning and Observations to Benefit the Environment)
- Learning Through Collaborative Visualization (CoVis) Project
- Middle School Mathematics Through Applications Projects (MMAP)
- Little Planet Literacy Series
- The Belvedere System
- STELLA
- GenScope Project
- SMART (Special Multimedia Arenas for Refining Thinking)
- DIAGNOSER
- Classtalk
- CSILE (Computer-Supported Intentional Learning Environments, a.k.a. Knowledge Forum)
- Challenge 2000 Multimedia Project

- Sherlock Project
- Geometry Tutor
- PUMP (Pittsburgh Urban Mathematics Program)
- PAT (PUMP Algebra Tutor)
- Kids as Global Scientists (KGS) Research Project
- American Schools Directory (www.asd.com; has a page for every K–12 school in the U.S., both public and private, with opportunities for cross learning and cross fertilization with such services as a wish list for requesting help, along with a free e-mail address option for any student or teacher)
- Teacher groups:

  LabNet Project (physics)

  Bank Street College's Mathematics Learning project

  QUILL (Alaskan writing teachers)

  HumBio Project (biology)

  WEBCSILE

  TAPPED IN (Teacher Professional Development Institute)
- Resource databases such as that provided by the Indiana University and the North Central Regional Educational Laboratory at www.ncrel.org.

TOPIC 20.17 Two Modes of Processing Information

Seymour Epstein (1994), in reviewing more than 30 different studies on human information processing, has identified two independent yet interactive methods that individuals use: *experiential* and *rational.* These two modes have been given various names over the last

century; seeing all these different names together (table 20.1) is a powerful argument for their prominent role in human learning.

Table 20.1. Two Modes of Human Information Processing

Mode	Experiential/Narrative (Learning Feelings and Behaviors Through Schemas)	Rational/Expository (Learning Attitudes and Beliefs Through Language)
Defining Characteristics	Unconscious, emotionally engaging, personally convincing, interpersonal, automatic, independent of intelligence and age, storylike, concrete, specific, promitive, simpler, perceptual, positive, imagistic, rapid, more effective in changing feelings and behavior	Analytical, conscious, formal, theoretical, more complex, general, removed from direct experience, capable of negation, abstract, public, logical, structural, organized, comceptual, more related to verbal, numerical, and spatial intelligence
Traditional Synonyms for Mode Title	Unconscious	Conscious
	Nonverbal	Verbal
	Procedural	Declarative
	Contextual	Propositional
	Prototypical	Logical
	Episodic/procedural	Semantic
	Tacit/implicit	Explicit
	Mythos	Logos
	Natural	Extensional
	Automatic	Reflective
	Heuristic	Effortful
	Direct, behavioral experience	Indirect, nonbehavioral experience
	Narrative	Propositional
	Biological	Conceptual
	Implicit	Self-attributed
	Biological	Linguistic
	Prewired	Intentional
Typical Learning Strategies Associated with Mode	Stories, settings, intentions, emotions, actions, scripts, narratives, plots, moods, five senses, images, pictures, acting, movement, feedback mechanisms, metaphors	Charts, tables, exposition, diagrams (non-narrative), formulas, systems analysis, symbol systems, organizational methods, process designs

Source: Adapted from "Integration of the Cognitive and the Psychodynamic Unconscious" by Seymour Epstein (August 1994), *American Psychologist,* 49(8), 709–724.

People who are strong in one mode may be weaker in the other. Even when learners are strong in both modes, redundancy in instructional design will result in greater learning by the greater number of learners. Consider

your favorite speaker (lecturer, rabbi, mullah, and so forth); one reason you like him is probably that he balances abstract points with concrete examples, and not too much of either. An excellent example of this balance, at least in the domain of writing, is the work of the *New York Times* international affairs writer Thomas Friedman. In his works, such as *From Beirut to Lebanon* and *The Lexus and the Olive Tree* (on globalization), he begins each chapter with an abstract point, then proceeds to illustrate it abundantly with concrete stories and other examples.

The experiential mode could be described as more right-brained, the rational mode more left-brained. Arthur Glenberg, psychologist at the University of Wisconsin–Madison, has developed the *embodiment theory* of memory—that human memory is designed to remember action, not the abstract. Elaborating on this idea in "What Memory Is For," his paper in the journal *Behavioral and Brain Sciences* (1997), Glenberg says this explains why people are more likely to remember how a machine operates after seeing it demonstrated than after only reading about it. Glenberg's theory seems to relate to the two modes of Epstein—and the two hemispheres, especially concentrating on the experiential mode.

Applications

❶ Ensure that your learning design contains a balance of experiential and rational learning strategies. For example, for every expository definition given to the learner, provide a story that illustrates it.

❷ For every point you explain, tell a story to illustrate it.

❸ For every essay you write, find a narrative or story to illustrate the concept. For every story you write or tell, identify the concept or point that it illustrates. This is the technique for Aesop's fables, in which each story ends with an aphorism.

❹ For every drama, review criticism.

❺ For every activity, talk about it (called "processing" in human relations parlance).

❻ For every lecture, conduct an experiment. For example, if you are lecturing on African history, get the class to make some predictions about their peers' knowledge, then confirm by asking, for example, "How many of you know where Nigeria is located?"

❼ For additional ideas on how to balance the two modes, read Don Norman's *Things That Make Us Smart* (1993).

Strategies for How We Might *Organize* to Learn

TOPIC 20.18 Breaks

Research reveals at least two good reasons to take breaks after each learning module. First, new neural connections formed by learning need time to fix and strengthen themselves without competition from additional novel stimuli. A simple walk around the block can provide such jelling time. This is like the need in darkroom photography for a "fixing" chemical to stabilize the photographic image. Second, because of fatigue factors, errors increase as break time decreases.

Applications

❶ Some form of exercise is an excellent follow-up to a learning episode because of the impact of the extra epinephrine on the formation of neuronal connections. Perhaps you could lead your students in stretching, bending, and breathing exercises after a learning episode.

❷ The best time of day to take in new material is just before going to sleep. Research indicates that material studied just prior to sleep onset tends to be remembered better. Sleep, in one sense, is another way to take a break. Encourage learners to do memory work before going to sleep.

❸ In classes of adults, announce that students can leave the room whenever they wish, but also have periodic, scheduled breaks. *(Contributed by Jack Wilson)*

TOPIC 20.19 Chunking

Make an effort to limit the introduction of new information to groupings of about seven of anything. G. A. Miller (1956) has demonstrated that seven new and previously unassociated bits of information (like those found in a telephone number) are about as much as most people can work with. Once the seven or so bits of information have been mastered, they become a chunk and behave as one bit. See more about Miller and the "magical number seven" at topic 20.2.

Applications

❶ If you want people to remember a list of 10 or more items, either (a) somehow reduce the list to 9 or fewer items (preferably 7) or (b) break up the list into two or more units of 7 chunks each, master the first list of 7 before moving on to the second, and so on.

❷ Where possible, take a longer list of, say, 15 or 20 items and reduce it to about 7 by identifying the biggest categories. Then learn the original list as subcategories of the shorter one. Work on the 7 main categories until they have been mastered; then work on the sets of subcategories one by one until you have learned the entire list.

❸ For verbal passages, start by mastering the first 5–9 words or chunks. (A familiar phrase such as "Old MacDonald Had a Farm" counts as one chunk.) Then learn the next 5–9 words or chunks. Put them all together and continue in the same way. For example, treat the sentence "'Old MacDonald Had a Farm' is one of my favorite childhood songs" as 8 bits—the song title itself counts only as 1 bit, as the original 5 bits of the title have become routinized,

and are now a "chunk," or a single memory element—the 5 have become 1.

❹ For lists of numbers, look for combinations that can serve as chunks for you. For example, with the list of 611959, I could remember it as two chunks: my height (6'1") and my high school graduation year (1959).

TOPIC 20.20 Control

The teacher is the one person most able to influence the learner's sense of control over the learning process. If the learner feels in control, a wider range of learning, both rote and meaningful, can occur. If the learner feels highly controlled, only rote learning can occur. Caine and Caine (1991) call this *taxon* (list) and *locale* (map) learning. Locale learning encourages creativity, analysis, synthesis, planning, problem solving, and complex decision making. When the learner feels relaxed and in control, the cortex is fully functional and this higher-level, more meaningful learning is possible. When the learner feels out of control of the learning process, he or she "downshifts" (Caine and Caine, 1991) from cortical locale learning to the limbic system's taxon, or rote, learning. In this condition, the cortex essentially shuts down. The only learning possible involves rote memorization or learning of simple skills, and the only creativity or problem-solving possible is that which is based on habits, instincts, or other already learned routinized behaviors.

I do not advocate giving *complete* control to the learner—that can result in frustration. In a review of the research on discovery learning, Richard Mayer (2004) of the University of California, Santa Barbara, concludes that pure discovery learning—allowing students to explore material entirely on their own in hopes of spontaneous insight—yields lower student performance than guided discovery, in which teachers guide the exploration and nudge students toward discovery and insight.

Note: When you see cross references to other sections of this book, you may benefit from taking time now to read them; they provide information that will deepen your understanding

of the current material.

Sometimes stress, rather than lack of ability, is the reason people appear able to learn only simple, routine skills. Away from the sources of stress, they can be more creative and complex in their learning behavior. A stressful learning environment or classroom can itself prevent cortical learning, whether the stress is real or only perceived. Make sure that your classroom does not force downshifting. (For more on stress and control issues, see chapter 33.)

Applications

❶ At the beginning of a class, clearly establish learner control by reviewing class norms. For example, you might say, "Feel free to take a break when you need to," "Please let me know if you're physically uncomfortable, and I'll see what can be done about it," or "Please feel free to ask any questions whenever the need arises; the only dumb question is the unasked question."

❷ Help learners set their own goals for learning.

❸ Use effective listening techniques, such as active and reflective listening, paraphrasing, and clarifying, that have the effect of focusing on the learners and underscoring their control.

❹ Ask open-ended questions, which invite the learner to be more involved in the process. Avoid questions with yes-or-no responses, because they discourage involvement. And avoid questions starting with "Why . . . ?" This type of question tends to create stress in learners and make them defensive (see Flanders, 1970).

❺ Respect differences in learning styles by accommodating students' stylistic differences as much as possible: their need for cool or warm temperatures, preference for dim or full light, desire for snacks, or need for physical activity.

❻ Build in opportunities for participant involvement, such as role playing, case studies, simulations, investigations, interviews, construction, and small-group work. *(Contributed by Rick Bradley)*

❼ Don't assign seats; let participants select their own seats. If you want to mix the learners up after a break, ask them to select new seats with new people on either side. They will still maintain the same sense of control.

TOPIC 20.21 How Personality Traits Do and Do Not Support Different Kinds of Learning

The Big Five supertraits (see definitions and other material in chapter 30) comprise five pairs of polar behavioral tendencies. Each of these tendencies, or traits, is associated with specific preferences in learning situations. People who exhibit one extreme or the other of each pair of related traits (which fall on a continuum) will have clear preferences for the learning strategies listed in the Applications. Those whose behavioral tendencies are in the midrange for any pair of traits tend to exhibit a mixture of the two opposite traits, or just not as extreme a version of either of the two opposing traits. For example, introverts like quiet and solitude, while extroverts like action and groups, while ambiverts (like me) like not too much of either solitude or groups, or perhaps being around a few people but never around large groups and never alone. For more discussion of the relation between traits and learning needs, see the chapter on learning in Howard and Howard (2010), and throughout Howard and Howard (2011).

Applications

❶ Need for Stability:

a. For reactives: minimize stress, and if an attempt at a task fails, make sure to talk through how to approach the task next time.

b. For resilients: the amount of stress is essentially irrelevant.

c. For responsives: alternate between stressful and stress-free activities, or find activities that are all just moderate stress.

❷ Extraversion:

a. For extraverts: use physically active strategies with more people.

b. For introverts: use more sedentary strategies with fewer people.

c. For ambiverts (in between): either alternate between the two kinds of activities in (a) and (b), or find a happy medium—like small, relatively quiet groups.

❸ Originality:

a. For explorers: emphasize creative imagination and complex interrelationships.

b. For conservers: emphasize following directions and attending to details.

c. For moderates: use a balance of (a) and (b), or use strategies that are moderate in their demands for both imagination and detail.

❹ Accommodation:

a. For adapters: emphasize cooperative activities and minimize need for recognition.

b. For challengers: emphasize competitive activities and maximize recognition.

c. For negotiators: Use them as facilitators, and avoid the extremes of either (a) or (b).

❺ Consolidation:

a. For foc used: emphasize goal formation and methodology/planning for attainment

b. For flexibles: emphasize flexibility and spontaneity in moving from

project to project with lower need for completion before switching.

c. For balanced: moderate emphasis on goals but allow for some spontaneity.

TOPIC 20.22 Incubation

To come up with creative responses to problems, allow time for the information to incubate. As Louis Pasteur remarked, "Chance favors only the mind that is prepared." Do your homework; then let intuition work on it. When I was a first-year student at Davidson College, I had a tennis class under Coach Lefty Driesell. One day, after Lefty hit a ball past me, I shouted out, playfully, "LUCK!" Driesell stopped dead in his tracks, glared at me, and said, "There's no such thing as luck, Howard. It's preparation meeting the opportunity." For a more extensive treatment of incubation in terms of how it fits in with the four-phase model of the creative process, see topic 24.4.

Applications

❶ Allow for a substantial break, when possible, after problem-defining activity and before idea-generating activity.

❷ Many of us participate in team-building retreats. The best use of these overnight problem-solving sessions is to present the information (attitude survey results and so on) before bedtime, then, in the morning, after it has incubated, come up with creative responses in a planning session.

❸ Teams and departments often push through meeting agendas, grasping at the first suggestion that develops in order to get to the next item. Make it a group norm to allow for more incubation time when a matter is not urgent. Better planning is often the result.

TOPIC 20.23 Memory and Emotion

The role that emotion plays in the formation and recall of memory is not clear. We know that some minimal level of arousal, hence emotional activity, is necessary to pump sufficient adrenaline and noradrenaline into one's system to cause the memory to "take." On the other hand, we know that intense emotional experiences appear to interfere with memory formation. Marcia Johnson, a professor of psychology at Princeton University, has found in her research that experiences with intense emotional components appear to be remembered with fewer perceptual details (*APA Monitor,* October 1995). She also has found that focusing on the emotional aspect of a memory results in recall of less detail. More important, she has found that focusing on the emotional aspect of both real and imagined memories blurs the source of the memory.

Applications

❶ When you are attempting to reconstruct a memory that has a strong emotional component, be aware that you may have a tendency to supply details that are not, in fact, details of the experience (the emotions block acquisition of the actual details). Where possible, seek corroboration from another person.

❷ In an emotionally intense situation in which memory is important, try to find a moment of composure to focus on elements you need to remember.

TOPIC 20.24 Modalities

Much has been written over the last 30 years advocating the use of multiple sensory channels, or modes, for conveying instruction. Most individuals have a stronger, or preferred, mode—visual, auditory, or kinesthetic. Accordingly, if a teacher or trainer uses both visual and auditory modes to present information, the chances are enhanced that

people who prefer one of these modes will learn. This is related to Howard Gardner's work on multiple intelligences (see topic 29.4). In a recent study, researchers at the University of New South Wales reported that two simultaneous modes of presentation can often enhance learning **(***Journal of Experimental Psychology: Applied,* December 1997, pp. 257–287). For example, a learner could follow visual instructions and diagrams on a television monitor with auditory reinforcement of key points. The New South Wales researchers found that when two simultaneous modes each present complete details, one interferes with the other. It is better for one mode to present the complete set of instructions, with the second mode simultaneously presenting only bare, skeletal (schema-like) information that reinforces the key points of the primary mode. Two simultaneous presentation modes, each with abundant detail, violate the principle of attention (see topic 20.10).

Applications

❶ When you are lecturing or orally presenting information, ensure that your visual aids contain only key points. Otherwise, the details in the visuals will interfere with the details in the spoken presentation. When you need to switch modes in order to present complicated visual information, as in a large, row-by-column table, then you should slow your speech to make only key points while the learners focus on the details of the table.

❷ When you are presenting information kinesthetically, as in demonstrating a movement with the learners moving along with you, don't be tempted to fill in the silence by talking the entire time; speak only to make key points.

❸ When you are presenting information visually, as in a videotape or DVD, the most effective sound track will make sparing commentary, and only to emphasize key points to focus the learners' attention. Don't distract learners with chatter. If you need to talk, let the visual mode subside by using a freeze-frame or some repetitive action.

TOPIC 20.25 Schemas

British psychologist Frederick Bartlett (1932) was the first person to propose a theory of abstract cognitive structures called schemas. A *schema* is an outline, a skeleton, a map that defines the essential structure, the logic, for a particular type of experience. For example, I have a schema for preparing scrambled eggs. My schema may or may not be similar to your schema for scrambling eggs. When schemas are similar to an actual experience, they render our memories of that experience accurate; if they are different, they color our memories accordingly. In other words, if I depart from the way I normally cook eggs, perhaps because of a telephone interruption, then later in the day when I attempt to recall my egg scrambling, I am likely to remember the cooking not as it actually occurred, but rather to conform with my schema. The biological basis of a schema is a neural pathway that represents the schematic diagram of a specific cognitive process. We have schemas for telling stories or jokes, giving directions, and solving problems. We may even have several different schemas for each task. David Rumelhart (H. Gardner, 1985, p. 125) describes the standard schema for storytelling; I have summarized his description as follows:

1. State the goal.
2. Enumerate the steps to the goal (e.g., "Once upon a time, Little Red Riding Hood set out to visit her grandmother").
3. Relate the reactions along the way.
4. Describe and comment on the success or failure in reaching the goal.

Our schemas differ from each other's just as our experiences do. Someone who has learned the Chinese language will have different schemas from someone who hasn't. In one sense, the story of our mental life is the story of either (1) forming new schemas or (2) accommodating new experiences to old schemas. Most learning appears to be a process of fitting new information into old schemas. Unless we work hard to establish new schemas, our existing schemas tend to determine how we evaluate and shape

new information.

John Bransford, co-director of Vanderbilt University's Learning Technology Center, has determined that schemas play such a strong role in coloring new learning that learners can't help but modify what they hear and see according to their prior experience. Learners who hear "The doctor's son greeted his father" will typically tend to accommodate this statement to their schema about doctoring and see the son shaking hands with a father who is a doctor, rather than allowing for the possibility that the doctor is actually the mother, standing by and watching her son greet his father, who is not a doctor. In this sense, stereotypes are schemas. Bransford says that this tendency is so strong and so pervasive that the instructor must take responsibility for listening to students discuss their newfound knowledge and clarify instances of inappropriate accommodation to previous schemas. As Hodgson's law says, we tend to remember a thing the way we want to remember it.

An example of this is a story educator John Holt tells of visiting an elementary school and observing a geography lesson. The fifth-grade teacher was pointing to a wall map of the United States and questioning students about points of the compass. Holt, on a hunch, approached the wall map, removed it, and laid it flat on the floor. He then asked, "Which way is north?" All the students pointed toward the ceiling!

L. A. Hart (1983) defines learning as the acquisition of useful schemas, which he calls *programs.* He defines a program or schema as a sequence used for attaining a preselected goal. Programs are triggered when the learner recognizes a pattern or situation that somehow fits with the program or schema. For example, when I see a whining child (pattern), I use my "distract the child" routine (program), in which I move through my repertoire of quacking like a duck, making clicking noises with my tongue, crowing like a rooster, and so forth. If the program works (that is, the learner achieves the goal), fine; otherwise, the learner tries another program or looks for another pattern.

Mary Crawford (1995) has clarified the influence of gender differences in learning schemas. According to her research, many females acquire certain

schemas that males are less likely to acquire, such as "how to mend a shirt," while many males acquire certain schemas that females are less likely to acquire, such as "how to build a workbench." She has found gender differences in the amount of detail recalled when two groups are told the same story but given different titles, with each title representing a gender-specific schema. For example, most females will remember more detail from a story entitled "How to Mend a Shirt" than one entitled "How to Build a Workbench," even when the two stories are identical except for the title (that is, the story is about building a workbench that is used to mend a shirt).

Janet Kolodnor (1997) builds on the idea of schemas by demonstrating the effectiveness of analogous situations as a teaching tool. By relating new concepts structurally to familiar situations or schemas, learners demonstrate greater understanding and retention. For example, teaching the concept of how the multiple points of view in the Continental Congress in the early United States were satisfied might be simplified by convening a class meeting about a similarly divisive subject, such as how the school should or could treat the needs and desires of students and their families with respect to different religious traditions and holidays.

Applications

❶ Before teaching someone a new skill or body of knowledge, first find out what the learner already knows that is similar. Then proceed with your instruction, pointing out the ways in which this new learning is similar to or different from the learner's existing schemas. For example, if the learner is to learn arc welding, find out whether she has had experience with other kinds of welding machines, soldering irons, and so on. This is a normal part of the technical training model called *job instruction training* (see Eckles, Carmichael, and Sarchet, 1981, p. 340).

❷ As we get older, we have more complex and more numerous schemas to build on. This is particularly helpful in the *peg-word technique* for memorizing lists. Say that you want to memorize the 10 largest cities in the

world. You start by making a list of rhyming words for the numbers 1 to 10. You then think of an association between the rhyming word (the peg word) and the name of the city; the more whimsical or outrageous the association is, the easier it will be to remember. For example:

Number	Rhyme	City	Association
One	Bun	Tokyo	*Looks like the bow on the traditional Japanese kimono*
Two	Shoe	Mexico City	*Mexico as the shoe of the body of the North American continent*
Three	Tree	São Paulo	*The land of rain forests*
Four	Door	New York	*The traditional door to the United States for immigrants*
Five	Hive	Seoul	*A beehive of political activity*
Six	Sticks	Osaka	*"O sock-a me with the sticks"*
Seven	Heaven	Buenos Aires	*Heaven is good air ("buenos aires" = "good air")*
Eight	Gate	Calcutta	*"Cut a" gate into the fence*
Nine	Line	Bombay	*The coastline around the bay*
Ten	Pin	Rio de Janeiro	*Pin (blame) it on Rio (movie title)*

Once you've memorized the peg words (bun, shoe, and so on), all you have to do is form good visual associations between the peg word and the related item on the list you're trying to memorize. The mind can easily relate the schema of bun, for example, to both sweet rolls and the bow on the back of the kimono. See examples in Lorayne and Lucas (1974) and Buzan (1991).

❸ When you think a common schema exists for everyone in a group, you might refer to it in front of the whole class. For example, if you are talking about performance appraisal, you might discuss how it is similar to and different from traditional school report cards.

❹ Ask questions and provide examples that relate to the experiences of the learners. Help them to see the connection between their experiences and what you are teaching.

❺ Allow your learners time for exploration. Help them verbalize both the patterns they recognize and the programs and schemas they choose to apply (L. A. Hart, 1983). Here's a model of the process:

1. Recognize the pattern.
2. Implement the program.
3. Evaluate the program. If it fails, reinterpret the pattern, look for a new pattern, try a new program, or try a variation on the failed program.

❻ When using familiar schemas (basketball, cars, cooking, sewing) to explain a concept (for example, how to find a percentage), remember that some students will be unfamiliar with some of the schemas. Be sure to use a representative set of schemas in order to give all the learners an equal chance to learn the concept. Try to find more gender-neutral schemas (such as eating, swimming, or reading) to use as a basis for new learning. Test the intended schema with the group by asking whether everyone is familiar with it.

TOPIC 20.26 Spacing

In a classic 1978 experiment in educational psychology, British postal workers learned to use a new machine. Those who studied 1 hour a day learned twice as fast as those who studied 4 hours a day in two 2-hour sessions. The 2-hour group learned to use the machine in half as many days but spent twice as many hours learning. In other words, the more hours per day they spent in instruction, the more total time they required. Clearly this would be desirable only under a deadline. Prefer spaced to massed learning where possible. Learning is *spaced* if it is composed of multiple modules with a significant time lapse between the modules. Spaced learning for a given quantity of learning consists of shorter modules with time for practice and assimilation between the modules.

Harry Bahrick, a psychologist at Ohio Wesleyan University, believes that teachers should institutionalize spacing concepts. His research establishes the

superior effect of cumulative learning. The more that people study and review, the more they remember. He found that high school Spanish students who took five courses remembered about 60 percent of the vocabulary 25 years after finishing high school, whereas students taking only one course remembered almost none, in spite of the fact that neither group had used Spanish to a significant degree after high school. Again controlling for usage, he compared 1,726 adults who had finished high school 50 years earlier and found that those who had gone on from high school algebra and geometry to take college-level math at or above the level of calculus scored 80 percent correct on an algebra test. Those who took only high school algebra and geometry and did as well as the college math group in their high school math courses managed to score only slightly better than a control group who had taken no algebra or geometry at all in high school or anywhere else! Bahrick laments that we spend millions helping people learn, then let them forget what they learned.

Applications

❶ Try to schedule learning modules of no more than two to four hours per day; allow time and space for practice between sessions. If this isn't possible, build in frequent breaks.

❷ If you must have an all-day seminar, take extra care to allow participants time to read in advance and to practice and review afterward. Also, during the period of instruction, don't just keep presenting new information and skills. Allow ample time for assimilation (as in relating new information to previous information) and practice (as in role play, case study, and exercises).

❸ Schools should change from the quarter system to the semester system, and from longer class periods to more but shorter class periods.

❹ Schools and other learning organizations should require review of prior material both during the course and in subsequent courses.

❺ Schools should include cumulative courses that review and integrate prior courses and should give cumulative final examinations.

❻ Schools should offer courses that meet, for example, once a week for two or three years, rather than three times a week for four months. The general rule should be to spread out learning as much as possible—with frequent review—to maximize retention.

❼ Carefully plan training for new employees over time to avoid overwhelming them during their first days on the job. *(Contributed by Rick Bradley)*

❽ Schedule more frequent, shorter staff meetings.

❾ As an alternative or supplement to all-day seminars and workshops, use the Internet as a way to space out learning. Use such online learning platforms as eCollege, ItsLearning, EdTek, Breeze, WebCT, Scribe Studio, and Blackboard to present both information and practice, saving in-class time for critical discussions, demonstrations, and other activities.

TOPIC 20.27 The Development of Critical Thinking from Grade School Through University

Harvard's William Perry Jr. set out to describe (1970) the nature of intellectual growth that typically takes place during the college years. In so doing, Perry in effect identified three significantly different phases (with subphases) that amount to developmental stages or even styles:

1. ***Dualism,*** in which the entering college student tends to see the world in terms of right and wrong, or good and bad, and searches throughout most freshman and sophomore courses to find the right answers.
2. ***Relativism,*** in which the maturing college student tends to eschew the notion of a single right approach or answer, instead embracing a pluralism in which multiple points of view and value systems may be

simultaneously good or right.

3. ***Commitment,*** in which the mature college student, while continuing intellectually, or epistemologically, to embrace relativism and pluralism, nonetheless affirms a personal set of values. This commitment, however, is integrative and accepting of other systems, unlike earlier commitments, which were unexamined and based on unquestioned authority.

In a parallel work, Mary Belenky and others (1997) found that the traditional female in the U.S. entered college with no voice of her own, accepting instead her authorities' word for what was right and good. Belenky traces the process of such women (and, for that matter, men) discovering their voice. The stages are similar to Perry's.

How does one move a young person from dualism to relativism? In the mid-1990s I attended a workshop called "Critical Thinking for College Students" that was led by biology professor Craig Nelson of Indiana University (who, in recognition of his efforts in improving college teaching, was named "U.S. Professor of the Year" in 2000 by the Carnegie Foundation for the Advancement of Teaching). After reviewing the models of Perry and Belenky, Nelson pointed out that the mechanism for moving a young person in the direction of discovering her own voice was through the use of the "tools" of a discipline. By learning to use these, the student begins to think like a biologist, or a linguist, or a historian, and thus discovers her own voice.

I decided to make a list of the tools used in my primary discipline—industrial and organizational psychology. Here is a partial list:

- Key word/statement format
- "Two by" grids
- Row-by-column matrix
- Weighted row-by-column matrix (decision matrix)
- Flowchart
- Ishikawa chart

- Circular flow
- Mind map
- Open-ended questions
- Graph
- Likert scale
- Anchor
- Executive summary
- Continuum
- Time line (Gantt chart, etc.)
- Action plan
- Stepwise listing
- Consensus
- Itemized response/force field
- Diagram

From time to time, I teach undergraduate and graduate versions of an introductory course in industrial and organizational psychology, and teaching toward mastery of these tools is the basis of the course structure.

Tools vary somewhat from discipline to discipline. As Bransford and others (2000) put it: "The teaching of metacognitive activities must be incorporated into the subject matter that students are learning. . . . These strategies are not generic across subjects, and attempts to teach them as generic can lead to failure to transfer. Teaching metacognitive strategies [i.e., what I'm calling 'tools'] has been shown to improve understanding [in a wide variety of subject areas]." The student of biology learns taxonomic hierarchies and drawing techniques; of philosophy, the syllogism and the Venn diagram; of history, research tools for ascertaining facts. Across disciplines, one learns such tools as the flowchart, the decision matrix, and

concept mapping. By using these tools, the student learns to approach the content of a field the way a scholar would, eschewing textbook answers and instead finding solutions independently. Nelson has found in his own controlled studies that students actually master more content when the instructor emphasizes mastery of tools rather than the content itself.

Applications

❶ If you are a teacher or a manager, identify the tools of your discipline, then show your students or subordinates how to use these tools. Their success is directly related to tool mastery. Mastery of the tools should be a major component by which both students and workers are evaluated.

❷ For a way to start identifying both tools that are unique to your discipline and tools that are common to other disciplines, review my *Visual Tools for Knowledge Workers* (Howard, 2000).

TOPIC 20.28 What Makes Good Textbooks?

Apart from the content of the written material used in learning, two factors seem particularly important: *style* and *organization.* In regard to style, Suzanne Wade, a professor of education at the University of Utah, reported in a presentation to the American Education Research Association in April 1993 that concrete details and visual descriptive passages are more effective in making material interesting than are amusing anecdotes and sidebars. The former make the material not only more enjoyable, but more understandable; the latter may even interfere with learning by detracting from the in-depth pursuit of information. Wade found that technical language interfered with interest and understanding at more basic levels, whereas concrete and visual language aided interest and understanding (*APA Monitor,* July 1993).

In regard to organization, Walter Kintsch (1994) has found that *advance organizers,* when they are arranged the same way as the target text, lead to

higher scores on recall of information (see topic 22.1). However, when advance organizers are arranged differently from the target text, learners show higher scores on comprehension. Apparently, the latter condition forces more participation from the reader, hence deeper understanding. Kinsch also found that low-knowledge readers learn better from well-organized texts, whereas high-knowledge readers learn better from more loosely organized texts that do not spell everything out. Apparently, when more knowledgeable readers and learners see a well-organized text, they assume that they know most of it and opt not to "get involved" with the material. More loosely organized texts, such as casebooks, edited collections, and sourcebooks, are more inviting to the knowledgeable reader.

Applications

❶ For beginners, prefer texts and written materials that are well organized and that employ a concrete, visual style. Avoid highly technical language. Use advance organizers that parallel the organization of the text.

❷ For more advanced readers, prefer texts that are more loosely organized and that use a more technical style. Advance organizers should not be arranged in the same way as the text. Make advanced readers grapple and get involved with the material.

Strategies for How We Might *Practice* What We've Learned

TOPIC 20.29 Habituation

Habituation is the psychological term for "enough is enough." Our sensory receptors become aroused when a new stimulus begins, but if the new stimulus continues without variation in quality or quantity, our sensory receptors shut down from their aroused state, having become habituated, or accustomed, to the monotonous stimulus. A change in the quality or quantity of the stimulus will arouse the receptors again. This is

why, for example, it is hard to pay attention to someone who speaks in a monotone. It is also why people dining often add salt, pepper, or other seasoning after several bites. Druckman and Bjork (1991) emphasize the importance of varying training conditions to prevent habituation and its attendant inefficiency in learning.

City University of New York professor Tracey Revenson attests to the value of varying presentation style by emphasizing the importance of acting ability to good teaching (*APA Monitor,* January 1994, p. 40). She constantly varies energy level, perspective and role, pace, accent, mood, and more. In the same article in the *APA Monitor,* University of Southern Indiana professor Joseph Palladino stresses the effectiveness of using appropriate humor—that is, humor that fits the context. He teaches the concept of *successive approximation* (estimating the value of an unknown quantity by repeated comparison to a sequence of known quantities) by getting down on all fours and bleating like a sheep until the class successfully trains him to their desired objective.

Another approach to this topic is called *mindfulness,* which uses frequent changes in auditory and visual attention to maintain alertness. Borysenko (1987), Langer (1989), and Cooper (1991) each suggest specific techniques for avoiding the fatigue that results from sustained attention. A facilitator of learning should teach these techniques to the learners. Avoiding habituation, or attentional fatigue, is a two-way responsibility. The teacher can certainly provide a variety of stimuli, but the learner can also take preventive action. Mindfulness appears to be the flip side of the concept of "monkey mind," described in topic 33.1, application 7.

Applications

❶ Have yourself videotaped while teaching. Review the tape; critique yourself for signs of repetitive behaviors that might tend to lessen the alertness of your students: talking at the same pitch, the same volume, or the same speed (never even slowing down to make a dramatic point); using the same vocabulary (complex Greek- or Latin-derived words rather than simple

Anglo-Saxon ones); standing or sitting in the same place; walking in the same pattern (desk to window, window to desk, desk to window, and so on); limiting eye contact (always looking at the same three or four students or from window to ceiling and back); or waving your arm the same way for emphasis.

❷ Seek out authentic ways to vary your behavior to maximize students' alertness. Remember when the teacher played by Robin Williams in *Dead Poets Society* jumped up on his desk or walked the class into the hall to view a picture? He knew how to avoid habituation. Fight it like the pL*a*Gu*E*!

❸ Minimize learning tasks that exceed five to ten minutes, and search for ways to vary tasks to maximize the students' arousal: contrast lecture with discussion, whole-group or small-group learning with individual seat work, reading with writing, standing with sitting, computer work with face-to-face interaction, remembering and mastering with creating, practicing with critiquing.

❹ After each break, encourage the learners to take a seat in a different part of the room.

❺ Jump, clap, shout, throw, wave, stomp, roll, whisper.

❻ Offer graphs to trainers for feedback on how well they do with this habituation paradigm. I once was asked to observe a superintendent of schools as he conducted a staff meeting. He had a reputation for horrible meetings. The first thing I noticed was his monotone. I charted his variation in pitch, volume, tempo, vocabulary, posture, and gesture over time. The resulting graph showed nothing but a group of flat lines. It made the point; he understood why and how to improve.

❼ As a learner, keep shifting focus to avoid visual fatigue: don't focus on the same point for more than a few seconds; study an object for one minute, close your eyes and try to reproduce it in your mind's eye, then open your eyes and compare; remember to blink frequently; practice scanning by

looking for all the examples of one specific letter or number on a page; refresh your scanning skills by doing crosswords and jigsaw puzzles.

8 When learning, practice selective focus as a way of avoiding auditory fatigue. Pick out one of several auditory signals in your environment and focus on it exclusively, then pick another; when listening to music, select one instrument and focus on it for a while to the exclusion of other instruments, then shift to another instrument. When you are faced with the cacophony of two speakers blaring different voices or music, try alternating your focus between the two different signals.

TOPIC 20.30 Handle It!

One of the best ways to learn a body of information is to manipulate it in such a way as to make it yours. I have a friend who understood this principle in undergraduate school. After each lecture, he would return to his room with his notes, then sit at his typewriter and rewrite the notes in an outline form that was meaningful to him. Four years later, he had earned his Phi Beta Kappa key! To get a handle on it, handle it.

Another dimension of this learning principle was expressed by UCLA's Robert Bjork (1994, p. 192): "Manipulations that speed the rate of acquisition during training can fail to support long-term post-training performance, while other manipulations that appear to introduce difficulties for the learner during training can enhance post-training performance." I'm reminded of the passage from Aeschylus's *Agamemnon* that is variously translated as "Man must suffer to be wise" and "He who learns must suffer." Nothing new, that passage by Bjork. Easy come, easy go. The easier, more pain-free the practice is in the classroom, the more difficult it will be to transfer the information to the street, home, or workplace. After students show initial understanding, the instructional design should include variations, interference, distractions, and other difficulties that require the learner to struggle with the deep, essential structure of a new learning and not be content with just its surface structure.

In a study reported in the *Journal of Experimental Psychology: Learning,*

Memory, and Cognition (July 2001), Dominic Simon (McMaster University, Hamilton, Ontario) and Bjork (UCLA) compared different sets of skills learned in separate blocks versus randomly interleaved. Persons who learned in blocks felt they had better mastery, and they performed better the next day on a post-test than the interleaved learners. In fact, although the block learners *did* do better on the day of instruction, they performed measurably worse overall than the interleaved learners. Interleaving, such as by interrupting the learning or introducing difficulties, is worse for the short term, better for the long term. This is of significance for persons such as surgeons, who must learn separate skills over time but must ultimately use them together.

Bjork (1994, p. 188) recommends that learned material be *multiply encoded,* using multiple models, paraphrases, and examples rather than a single version: "The research is unambiguous: A variety of manipulations that impede performance during training facilitate performance on the long term" (p. 192). This principle of learning is often violated for several reasons:

1. Trainers and teachers are evaluated on a short-term basis.
2. Trainers and teachers typically don't see the long-term effects of the learning.
3. Follow-up is not usually done by the original trainer or teacher.
4. Trainers and teachers often confuse current success with future success.

Applications

❶ If you are a teacher and want to hand out an outline of your material, wait until after you've covered it. This forces the learners to write their own notes and struggle with the wording and outline. The act of having to "handle" the material helps the learners to build on their existing schemas. Alternatively, show the outline as an advance organizer (see topic 22.1), especially for learners unfamiliar with the content, but don't keep the outline available to

them. Release it to them later.

❷ If the material forms some kind of list or chart, put the elements on cards. Then have either individuals or groups arrange the cards in a correct or meaningful order.

❸ Have small groups generate their own examples of the point you are making.

❹ Use role playing.

❺ Have the learners write their own case studies.

❻ If the learners are to apply a skill (such as constructive criticism) to a job, have them write out a script to use.

❼ Examine books on the subject of TRICA (teaching reading in the content areas). These texts contain hands-on activities and are meant for high school teachers with students who do not read well. The activities work well as an adult learning technique, regardless of reading level.

❽ Have the learners prepare a presentation for each other. (Remember, the best way to learn something is to teach it.)

❾ Suggest that the learners make a presentation back on the job to others who are unable to attend. Allow time in class to begin work on such a presentation.

❿ Give the learners, alone or in groups, an unorganized list of all the elements of your presentation and let them decide how they'd like to organize it.

⓫ Have individuals or groups rank a list of items according to some criterion. This helps them to grapple with the concepts.

⓬ Vary the conditions of practice: schedule practice in a random fashion, minimize order and predictability, and vary the length, scope, distance, order,

resources, context, or subject.

⓭ Interrupt practice with both related and unrelated events and information.

⓮ Introduce the model (for example, with advance organizers) by using an outline that is inconsistent with the practice model.

⓯ Used spaced and distributed practice rather than massed practice (see topic 20.26).

⓰ Reduce feedback: use summary feedback after several trials, rather than feedback after each trial.

TOPIC 20.31 Peer Feedback

Peer feedback is more influential than teacher feedback in obtaining lasting performance results; too much of the latter can be harmful (Druckman and Swets, 1988). Apparently the approval or disapproval of one's peers is the best reinforcer. Excess feedback from the teacher can be perceived as being insincere if it is too effusive, or demotivating if it is too discouraging.

Applications

❶ Emphasize peer feedback for student performance in small groups or one-on-one interaction.

❷ One effective technique is to have graduates of a seminar meet in pairs over breakfast or lunch six months later for a follow-up session in which they discuss their successes and failures in implementing the class concepts and skills.

❸ In role plays, have all the participants do the exercise at the same time in groups of three—two to actually play the roles and one to help by making suggestions to a participant who is stuck and by providing feedback.

(Contributed by Jane Howard)

TOPIC 20.32 Practice for Simple Mastery

Allow ample time for practice. Supervised practice provides the feedback necessary to refine the learning, and practice in and of itself is crucial in converting the learning from short- to long-term memory (see topic 20.2). Practice clarifies and strengthens the neural connections that are formed while learning. But practice should not be mindless, as topic 20.30 points out. Appropriate complications in the practice program help build a deeper understanding of the schema underlying the new learning.

Robert Bjork (1994) comments that "people learn by making and correcting mistakes. We have known at least since [1955, in a paper by Estes] that it may be necessary to induce forgetting during training to enhance learning. Training conditions that prevent certain mistakes from happening (and give trainers a false optimism about their level of comprehension and competence) can defer those mistakes to a post-training setting where they really matter" (p. 201). Bjork warns that the principle of introducing mistakes into training is especially important in such roles as public safety officers, nuclear power plant operators, military personnel, and transportation workers. For these and other jobs, it is crucial that we look for *mistakes* during training, not the absence of mistakes. In a similar vein, Quartz and Sejnowski (2002, p. 244) write: "Experiments with animals demonstrate that the largest brain changes occur when novelty is maintained by regularly rearranging and changing the objects in the animal's environment, keeping the animals in a constant state of learning."

Applications

❶ Role playing is an effective way to practice, especially for interpersonal skills. Try to make it less intimidating by having several pairs or groups of three do the role play at the same time and then discuss the results together,

rather than putting two individuals on the spot in front of the class.

❷ Provide case studies, both off-the-shelf and real. They give learners the opportunity to practice applying their learning under your supervision.

❸ Introduce appropriate distractions, irrelevant information, and other real-world properties that make practice more mindful. For example, in role-playing a seven-step counseling interview, have the interviewee purposely lead the interviewer forward or backward in the process, so the interviewer develops a sense of understanding and control concerning the importance of managing the process firmly.

❹ When using a simulator (such as a flight simulator) for practice, the most important element is randomness, not physical appearance. The simulator should be psychologically faithful to the real world, not just faithful in an engineering sense.

❺ In batting practice, randomly varied pitches give better performance results than blocks of pitches (for example, 15 curves followed by 15 sliders).

❻ Practice skills that require identical performance conditions in a way that varies the conditions; for example, practice jump shots in basketball at varying distances and heights, practice point-after-touchdown conversions in football at different distances, timings, angles, widths, and heights.

TOPIC 20.33 Practice for Expert Performance

Anders Ericcson, Swedish psychologist and professor of psychology at Florida State University, has identified (Ericsson, Krampe, and Tesch-Romer [1993] a connection between quantity and quality of practice and attainment of expertise. First established with violin students in Berlin, this principle asserted that 10,000 hours of deliberate practice typically results in professional levels of expertise. Since his original research, Ericcson has found that the same principle holds true in other

domains. Malcolm Gladwell (2008) took Ericcson's findings and popularized them in his best seller *Outliers: The Story of Success,* applying the principle to Bill Gates, the Beatles, and others. The principle goes like this: Practice 10,000 hours over 10 years, varying your practice deliberately so as to introduce unusual or difficult constraints on your practice routine (e.g., changing hands, practicing with the radio on, standing in a bucket, and so forth), and you stand a chance of achieving professional or world-class levels of performance. Ten thousand hours over 10 years translates to approximately four hours a day for five days a week, 50 weeks a year (allowing for two weeks of vacation), for ten years, or 4 x 5 = 20, 20 x 50 = 1,000, and 1,000 x 10 = 10,000. But keep in mind that it is not just quantity of hours—if you keep doing the same thing over and over again you won't attain expert level. You have to introduce variation and difficulty. For additional explanation of how introducing difficulties into practice improves performance, review topics 20.30 and 20.16, both of which discuss Robert Bjork's notion of introducing "difficulties" into practice, which is the same thing as Ericcson's notion of "deliberate" practice.

As a side note, Ericcson found that the difference between professionals and amateurs is that the professionals put in the four hours of practice five days a week for ten years, while the amateurs, including teachers of violin rather than concertizers, put in around two hours a day.

Applications

❶ For any skill that you aspire to greatness, commit to an average of four hours of practice daily, five days a week, for a minimum of five years. Assuming that you do not commit to this regimen for more than one skill, this should allow plenty of time for other pursuits.

❷ Get clear in your head whether you aspire to the highest level (i.e., world class), a medium level (e.g., teacher or midlevel professional), or a modest level (e.g., amateur), and commit to your practice schedule accordingly.

❸ Keep in mind that some folks disagree with Ericcson's finding, inasmuch as they say that inborn talent can reduce the amount of practice required. However, to cover your bases, assume that talent doesn't count, and practice for all you're worth! If you manage to achieve world-class status with less practice, then thank your genes! But never take them for granted. As the pianist Ignacy Jan Paderewski once commented: "If I miss one day of practice, I notice; if I miss two days, my critics notice; if I miss three days, my audience notices." (Note: this is also attributed to others, including Franz Liszt.) Similarly, when an admirer of the violinist Isaac Stern gushed that she'd give her life to play "like that," he is said to have replied, "Ma'am, I did."

❹ Matthew Syed, currently a British journalist and formerly a top-ranked professional table tennis competitor, has written *Bounce: Mozart, Federer, Picasso, Beckham, and the Science of Success* (HarperCollins, 2010). This volume shows how to apply Ericcson's theory to a variety of skills. It is a must-read for anyone interested in expert performance—both theory and application in spades.

TOPIC 20.34 Self-Explanation

Michelene Chi (Chi, de Leeuw, Chiu, and LaVancher, 1994) reported on the effectiveness of allowing learners to explain what they have learned. Learners who give explanations of what they have learned achieve at higher levels; those who receive explanations from the teacher achieve at lower levels. This relationship holds true regardless of ability: both high- and low-ability learners who self-explain show 30 percent increases in achievement after learning, compared with only 20 percent for those who do not self-explain; the more explanation given (people who do this are called *high explainers*), the higher the gain. So, high self-explainers achieve more than low self-explainers, and low self-explainers gain more than those who do not self-explain at all. This topic actually serves as an elaboration of topic 20.30 ("Handle It!"): verbal self-explanation is a way to personally become

involved with content by handling information.

Applications

❶ Ask learners to explain what they have learned, both during and at the conclusion of a learning episode. Encourage them to put it in their own words.

❷ A variation on application 1 is to ask learners who've arrived at a wrong or unacceptable conclusion or solution to explain the process that led them to the wrong answer. By talking through the process, either the learner or you as the listener-facilitator can identify errors in the process that account for the unacceptable answer. Educator John Holt advocated this practice in his book *How Children Fail* (1983). I once had the opportunity to tutor a neighbor's middle school daughter in mathematics. My strategy was simply to have her talk through the steps she had used for each of the problems the teacher had marked as wrong. In each of the wrong answers, we were able to spot an error in her process of problem solving. About halfway through the session, she remarked to me, "This is fun! I've never done this before." I asked what it was that she hadn't done before. She replied, "The teacher always goes over our wrong answers. I've never had a chance to talk about how I solve them with the teacher listening to me!"

❸ Occasionally, even though a learner has arrived at an acceptable answer, you are not certain that the process that got her there was sound; in other words, the learner may have been lucky. In such a case, asking her to give a self-explanation by narrating how the conclusion was reached would help to clarify whether the result was luck or skill.

❹ Employ learning activities (either spoken or written) that engage the learner in summarizing or paraphrasing an experience.

TOPIC 20.35 State Dependence

People recall information more readily when they can remember the state in which they learned that information. This is the basis of the old advice to play back in your mind everywhere you've been in the last 30 minutes when you want to find an object you've lost in that time period. In one research study, subjects memorized a list in the basement of a building and were tested. When they were moved to one of the upper floors of the building and were given the same test, they scored poorly. They then were asked to visualize the basement in which the memory task occurred, and their scores improved; when they were returned to the actual basement room where they had memorized the list and were tested again, their scores improved even more. This phenomenon is called *state dependence,* the theory that recall of learning can depend on the state or other situation that existed when the learning took place.

State dependence is reported to hold true for place (as in the basement example), mood (if you were angry when you learned, remember the anger), odors (remember that the olfactory sense is located in the limbic system), and physical condition (if you were drinking coffee while you were learning, you will remember better whenever you drink coffee). Why? Apparently, the synapses formed to create a specific memory are connected to neural networks that form the basis of the conditions associated with the time and place of learning. Recalling the place (for example, a specific room in a house) where you learned a person's name will help you to access the name, because the two are connected by neural networks. This is similar to taking a photo of a person against a distinctive background.

Applications

❶ When you are with someone who is having a hard time remembering something you both want to remember, get the other person to focus on the place, the mood, and his or her physical condition when the information was learned. The same goes for you if you're trying to remember something.

❷ Make an effort to learn things under conditions that are easy to replicate

when you need to remember what you've learned.

❸ When you are trying to teach job-related skills, create a learning environment that approximates the conditions on the job. *(Contributed by Rick Bradley)*

TOPIC 20.36 Testing as a Learning Process

Classroom testing generally comes in two types: formative and summative. *Formative testing* provides feedback on the degree to which the learner is forming correct notions of the content; *summative testing* is typically done at the end of the unit or course to measure the sum, or final state, of the learner's knowledge of the subject. This section is about formative testing, which we will refer to simply as "testing."

Testing learners helps them to remember, according to Ronald P. Fisher of Florida International University. Some of his findings:

- Learners who take pretests do better on their finals.
- Learners who take pretests with fill-in-the-blank questions do better on their finals than those who take pretests with multiple-choice questions.
- Learners who take pretests with inferential multiple-choice questions do better on their finals than those who take pretests with factual multiple-choice questions.

Apparently, testing gives the learner an opportunity to practice several effective learning procedures simultaneously. Tests do not have to be punitive, or even graded, to be effective. It is the act of taking the test that is helpful. As Bransford et al. (2000) put it, "Feedback is most valuable when students have the opportunity to use it to revise their thinking as they are working on a unit or project" (p. 141).

Bruce Tuckman, psychologist at Ohio State University, compared three treatment groups: spot quizzes, homework, and classwork only. Spot-quiz students outperformed the homework students by 16 percent and the

classwork-only group by 24 percent. He further found (reported in *APA Monitor,* October 1999) that students with low grade averages showed the most improvement. Students prone to procrastinate also showed more improvement than students not prone to procrastinate.

L. A. Hart (1983) argues that *nondirective tests* (in which the learner must figure out the relevant patterns and programs, as in essay, short answer, and fill-in-the-blank questions) are superior to *directive tests* (in which the key patterns and programs are presented to the learner). In a multiple choice test, for example, the pattern is explicitly presented, as in "J. S. Bach composed music in which style or period?" and the program options are clearly delineated, as in "a. Classical, b. Romantic, c. Baroque, d. Renaissance." A purely nondirective form of the question would be: "Based on your knowledge of the history of music, list a minimum of five composers in each of the major historical periods of musical composition." These nondirective questions are superior, according to Hart, because learners have to identify patterns and select programs, thus strengthening the neural pathways necessary for retrieval.

Applications

❶ Use the beginning of a class session to review content from previous sessions. For example, in reviewing a decision-making process, you might ask a series of questions such as "What is the first step?" "Why does it come first?" "What step is most frequently skipped?" "Why is it hard to remember?" This is a good way to use time while waiting for everyone to get back from a break.

❷ Use group competition in tests. For example, divide the learners into small groups and have them make a list of the steps of a process you taught in a previous session. Let the group that finishes first recite the steps to the other groups. If they make an error, let another small group recite from that point, and so on.

❸ Place learners in small groups and have each group construct a test to give to the other groups. This builds on the principle of "Handle It!" (see topic 20.30).

❹ Use card sorts to see if the steps of a process have been learned. For example, in an organization with an elaborate 17-step performance appraisal process, the trainer made decks of 17 cards each, with each card containing an unnumbered step of the process. The learners had to arrange the cards in the proper sequence, as individuals and as groups, and were allowed to review one another's work until they all thought they were right. The preferred solution was then revealed. You should be open to the possibility that in such a case the class may come up with an improvement to the process!

❺ If possible, choose tests that require the learner to identify a pattern (for example, somebody doing a poor job of listening to someone else) and then to identify an appropriate *program* to apply (for example, a clarifying question).

❻ Start a training session with a pretest that includes some of the more unusual points you will cover in your session. *(Contributed by Jane Howard)*

TOPIC 20.37 Visualization

When you're preparing for an event, remember the importance and effectiveness of visual and mental rehearsal in combination with physical rehearsal and practice. Visualization, also referred to as mental practice, has been shown to be effective in improving motor skills, although there is no evidence that it improves cognitive and behavioral skills (see Druckman and Bjork, 1991, and Gawain, 1978). University of Chicago neurologist John Milton has used EEG measures to study the effectiveness of visualization techniques on athletic performance. While helping Olympic golfers improve their swing technique, he observed that subjects showed the

more active beta waves on the left (more analytical) side of their brain while mentally rehearsing a shot, and calmer alpha waves on the right side of the brain while actually executing the shot just visualized. He refers to this shift from beta to alpha as going from active concentration into a kind of "zone" associated with peak performance (see Csikszentmihalyi on "flow" in topic 34.1). Milton found that the golfer's accuracy increased after these visual rehearsals.

Application

❶ If you are an athlete, executive, actor—anyone wanting to achieve a smooth, masterful performance—close your eyes and internally simulate the performance in your mind. Allow yourself to accompany this visualization with approximate physical movements or pantomime.

Some Myths about Learning

In 1984, the U.S. Army Research Institute asked the National Academy of Sciences to form a committee to evaluate "nonordinary" techniques for improving human performance. This request followed the urging of some who felt that "New Age" educational technologies that had been developed outside the mainstream might have some basis for their claims of achieving high results. The defense establishment was willing to consider any technique that might provide a competitive edge in the armed services. John Swets, a consultant from Cambridge, Massachusetts, was appointed chair of the committee, and Daniel Druckman, formerly of the consulting firm of Booz Allen Hamilton, was appointed study director. Their results were published as *Enhancing Human Performance: Issues, Theories, and Techniques* (Druckman and Swets, 1988).

During the next two years, reaction to this publication was intense and widespread. As a result, the committee re-formed in 1990 to evaluate areas that had not been included in the earlier study and to address concerns raised by that study. Robert Bjork was brought in as committee chair and Druckman

was retained as study director. Their findings were published as *In the Mind's Eye: Enhancing Human Performance* (Druckman and Bjork, 1991). Several of the findings in these two books have been presented in this and other chapters. Table 20.2 focuses on some "myths" about learning—learning methodologies that claimed positive results but didn't stand up to the scrutiny of these two committees.

Table 20.2. Some Myths about Learning

Method	Conclusion and Comments
Learning during sleep	There is no evidence of this with verified sleep. There is some evidence with light sleep. It is difficult to verify sleep stages. This technique is worth a second look. Disturbing sleep raises ethical issues.
Accelerated learning (SALTT, Suggestopedia, SuperLearning)	Of 11 elements identified, only two were nontraditional and both were found to be ineffective: relaxation (too much of it causes lack of focus) and review with music (it interferes with attention). No basis was found for the high claims. Good accelerated learning is basically no different from good teaching generally. Claims of 5- to 50-fold improvements were based on poor research designs. The two best studies (Bush, 1986; Wagner and Tilney, 1983) found that SALTT produced 40–50 percent lower results than traditional methods. The other nine elements of accelerated learning were all deemed to be traditional characteristics of effective teaching already in mainstream use: advance organizers, dramatic presentation, spacing, practice, mnemonic aids, student-generated elaborations, tests, imagery, and cooperation in groups.
Altered consciousness	This is an optimal arousal concept worth further research. Devices such as Hemi-Sync that stimulate a specific hemisphere appparently do not enhance learning. A satisfactory methodology is unavailable for researching these claims.
Neurolinguistic programming (NLP)	There is no evidence that one person can influence another as a result of matching representational systems. It is difficult to isolate individual variables in NLP research. There are poor dependent variables in much of the research (for example, "client-therapist empathy" is a vague dependent variable).

Parapsychology	It doesn't work. Existing programs at Stanford University, Princeton University, and Brooklyn's Maimonides Medical Center, and in San Antonio, should be monitored. Researchers need to agree on a research methodology.
Subliminal self-help	There is no evidence, either theoretical or experimental, for the effectiveness of this technique.
Meditation	Meditation is no more effective in reducing arousal than just resting quietly. There is no evidence that soldiers can be taught "soldier-saint" superhuman skills by yogis.

A Final Word on the Role of the Teacher

Harvard psychologist Ellen Langer (1997) has launched a major initiative to change classroom education from a world based on right answers to one based on flexible thinking. Accordingly, she proposes that seven myths permeating classroom education seriously curtail the learning process **(***APA Monitor,* August 1997, p. 97). Following is my adaptation of the list of myths that she challenges:

- *Myth 1.* The basics should be learned so well that they become second nature. (*Fact:* Overlearning stifles creativity and individual expression.)
- *Myth 2.* Paying attention means staying focused on one thing. (*Fact:* Novelty, as in examining unfamiliar aspects of familiar objects, persons, and things, holds attention.)
- *Myth 3.* Delaying gratification is important. (*Fact:* Keeping the fun in learning leads to more meaningful learning.)
- *Myth 4.* Rote memorization is necessary in education. (*Fact:* Students who relate material to personal experience do better than memorizers on tests of comprehension.)
- *Myth 5.* Forgetting is a problem. (*Fact:* Memory can be a straitjacket,

preventing the formation of novel uses and applications.)

- *Myth 6.* Intelligence is knowing "what's out there." (*Fact:* Lifelong learners, not know-it-alls, are the true experts.)
- *Myth 7.* There are right and wrong answers. (*Fact:* Correctness is dependent on context.)

In a masterful summary of the effectiveness of training, Robert Bjork (1994) points out that current research challenges two traditional—and incorrect—assumptions about training: that it should be relatively risk-free (that is, it should protect the learner from the pain of making errors) and that it should be orderly (with no skipping around). Bjork argues that simple and orderly learning provides good short-term results, such as A's on tests at the end of the course and high marks for the teacher. However, "simple and orderly" does not establish memories that last for the long term. Learners need multiple ways of experiencing a new concept or skill, and unpredictable opportunities to practice it, in order to understand it and have access to it for the long term.

Bjork supports his argument with two storylike experiments. A control group of batters on a California State University baseball team practiced hitting first 15 curve balls, then 15 sliders, then 15 fastballs. The experimental group practiced hitting 45 pitches, but in random order. The latter group outbatted the group with the simple and orderly batting practice. In the second experiment, two groups of eight-year-olds practiced throwing beanbags into a bucket. They were to be tested at a distance of three feet. The control group practiced all throws from a distance of three feet; the experimental group practiced some throws from two feet, others from four feet, and *none* from three feet. Guess what? The latter group outperformed the former, even though the experimental group had never had an opportunity to throw from the distance used in the final test.

This chapter is lengthy and, although thoughtfully organized, it may nonetheless feel choppy. You may feel like you're in a store with shelves full of choices. The job of the teacher is to pull from the shelves the elements that make sense for us as we prepare to facilitate the learning of others, and then

to find a way to integrate them in a way that works for us. It is helpful to see how others have done so. Dr. Susan Close has executed this job better than anyone I've witnessed. A former teacher and school administrator, and now a consultant and trainer, Susan has integrated all of the metacognitive tools gleaned from brain research and personal experience and formed an approach to teaching called SmartLearning. Learn more about her approach at www.smartreading.ca.

SUGGESTED RESOURCES

Ambrose, S. A., M. W. Bridges, M. DePietro, M. C. Lovett, and M. K. Norman (2010). *How Learning Works: 7 Research-Based Principles for Smart Teaching.* San Francisco: Wiley/Jossey-Bass.

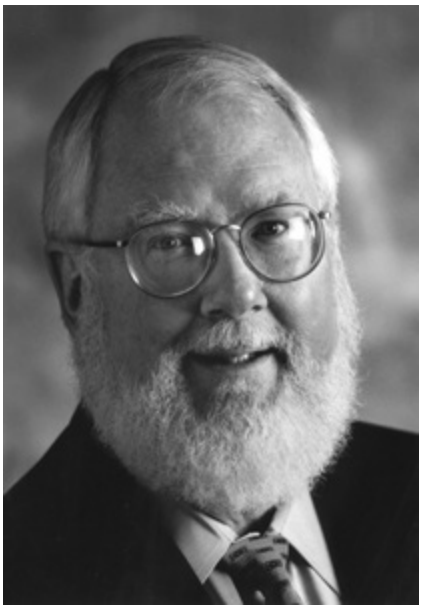
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The Author



Pierce J. Howard is director of research of the Center for Applied Cognitive Studies (*Cent*ACS), a research and dissemination firm headquartered in Charlotte, North Carolina. His wife, Jane, is managing director at *Cent*ACS. Together, they develop both public and organizational programs based on the most current research in cognitive science. These programs include workshops, breakfast seminars, speeches, retreats, a website (www.centacs.com), custom-designed programs, and publications. Their special focus is on the Five-Factor Model of personality, for which they offer certification training and a wide range of support materials, software, services, advanced training programs, and annual learning conferences.

For the last 40 years, Dr. Howard has also been an organization development consultant. His motivation and, hence, his own professional development stem from a deep-seated desire to help others learn how to overcome their obstacles. He has attended numerous workshops and professional meetings, read extensively in the field, conducted computer

database searches, and created hundreds of workshop designs in an unrelenting effort to find the best ways to help people solve problems, make decisions, create new approaches, and understand themselves and others—in effect, to take responsibility for their own growth and development both as individuals and as members of teams and organizations. Dr. Howard's skill and interest in debunking myths and finding the most effective ways to help others learn has served him well in the business community.

Dr. Howard grew up in Kinston, North Carolina. He received his B.A. degree in 1963 from Davidson College and his M.A. degree in 1967 from East Carolina University, both in English. In 1972, he received his Ph.D. degree in education with a special emphasis in curriculum and research from the University of North Carolina at Chapel Hill. His college years were interrupted by a three-year tour with the U.S. Army in Germany, where he served as an intelligence specialist.

In addition to his writing, research, and dissemination responsibilities, Dr. Howard serves as Adjunct Professor of Organization Development at the McColl School of Business, Queens University, Charlotte, NC. His professional affiliations include membership in the American Psychological Association, the International Society for the Study of Individual Differences, and the Organization Development Network. In 1992, the Charlotte Area ASTD Chapter recognized him with its Excellence in Service to the Profession Award. He has written and published numerous workbooks, tests, and other materials for clients. The first edition of this book, *The Owner's Manual for the Brain,* was published in 1994. In 2001, Pierce and Jane Howard published *The Owner's Manual for Personality at Work* (Bard Press). In 2006, Pierce and Jane published *The Owner's Manual for Personality from 12 to 22*, a parallel version of the previous book that applies personality theory to the adolescent years. In the same year, Pierce and Jane came out with the second edition of *The Owner's Manual for Personality at Work*. In August of 2013, Pierce published *The Owner's Manual for Happiness: Essential Elements of a Meaningful Life*. For relaxation, they enjoy walking, cooking, chamber music, choral singing, reading, and camping. Their older daughter, Hilary, is a journalist and actress in New

York, and their younger daughter, Allegra, is a Jazzercise manager and medical risk specialist in Charlotte. Together, they have provided the authors with four grandchildren as a sure way to remain young at heart (and mind).

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